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PURPOSE : *Indian Educational Review* is published twice a year, in January and July, by the National Council of Educational Research and Training, New Delhi. The purpose of this journal is to provide a medium for dissemination of educational research and exchange of experience among research workers, scholars, teachers and others interested in educational research and related fields and professions.

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CONTRIBUTIONS : *Indian Educational Review* invites papers on or pertaining to educational research with emphasis on research problems in Indian education. The editors entertain the following types of material :

1. Papers that contain original thinking in education or educational research.
2. Papers that make a significant contribution towards developing a theory.
3. Papers that summarize and discuss an outstanding study or piece of educational research.
4. Papers that review significant research in important areas.
5. Letters to the Editor on important research problems

The emphasis is on categories 2, 3, 4 and 5. Ordinarily a paper is not accepted if it has appeared in print in any form elsewhere. Exceptions may be made for contributions which the Editor considers should be made known to a wider public. In such cases a copy of the publication in which the paper has appeared earlier should be sent with it.

Manuscripts sent for consideration should be typed double-spaced on one side of the paper only. References in the text to the work of other researchers should be made by giving the name of the researcher, and the year in which his research was published, in round brackets and *not* in the form of serial numbers which connect with the list of references at the end. Typescript in duplicate should be sent to the Editor, and at least one copy retained by the writer for reference.

Tables, charts and graphs should be finalized carefully before sending. They should be clearly and accurately captioned and inked to size, and their places designated in the manuscript.

(Contd. on Cover III)

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CONTENTS

The Concept of Work-Experience

D. Blandow
M. S. Murari Rao

Work-experience is important for a technologically advancing society, both because it is needed for adjusting to work and because the skills which were transmitted from father to son in a handicraft society are no longer so transmitted. India has been attempting to incorporate work elements in its education since Gandhi. The concept of work-experience as an element of general education is examined by the authors: It is important at the primary stage to stress understanding of the means and media of technical work besides developing basic skills. At the upper primary stage it is necessary to stress precision and quality in a limited number of tools and operations. At the secondary stage, students may be given the option of exploring in depth one of the several areas already explored earlier.

For centuries excelling in skills in various fields such as metallurgy and textiles, Indian society remained basically agrarian during technological tide that swept the western countries during the last two centuries.

During the two centuries under the British rule, the objectives of educational system in India were obviously neither in conformity with the national needs, nor were there adequate means available to strengthen some aspects which did reflect the vital needs, e.g., the provision of instruction in arts, crafts, technical and vocational pursuits although Hunter Commission (1882), Hartog Committee (1929), and Sapru Committee (1934), Abbot and Woods Report (1936) and Sargent Report (1944) emphasised the need therefore.

Mahatma Gandhi's idea of a self-supporting educational system at primary level for the village, the basic social unit of India, developed into the first indigenous efforts known as the 'Basic System of Education' (1937).

The fast changing context, several complex controversial issues and handicaps were involved. As a response, Mudaliar Commission (1953) recommendations for diversified course in Secondary Schools.

In spite of comparatively better resources made available to develop multipurpose higher secondary schools, many causes led to a situation where multipurpose scheme was slowly abandoned. The heterogeneity of the educational systems in various states, total absence or unharmonised and out-of-phase operational plans, non-availability of proper and adequate teachers, the unchanged overall educational pattern and no adequate steps to change the centuries old attitudes of disdain for manual work were some of these causes. Strangely enough, it happened so gradually, and unceremoniously that the vacuum created for last six to seven years due to non-implementation of Kothari Commission (1964) recommendations hardly generated any national concern. This was perhaps due to the nation facing such crises as Chinese and Pakistan aggressions.

Kothari Commission (1964) has summarised a wide compendium of ideas, practices and problems of education such as "vocationalisation of education", "girls education", "science education in rural primary schools", "adult education", "occupational education and training", "problems of education of the unemployed", "introduction of work-experience as an integral part of primary education" and on "universal and free primary education". Parti-

cular stress has been laid on "democratisation of the total school system in India" as the main task for the years to come.

While separate vocational schools have been envisaged by the Kothari Commission, it has emphasised in clear cut terms that one of the means of achieving the national goals is by linking education to productivity and this link can be forged by introducing *work-experience* as an integral part of general education.

Genesis of the Term

It is well known that the existing system of education in our country is largely unrelated to the life of the students and the life around them. It is also apparent that there is a wide gulf between the actual content of education, its stated purpose and the real concerns of national development. One of the main tasks before the country today is to secure rapid economic development, to augment the G.N.P. and to provide a higher standard of living to the people. An essential prerequisite for the successful accomplishment of this hard task is the provision of a close link between education, life and productivity. Education will also have to strive consciously to develop in students the right attitudes and values that are needed for a democratic and socialist society. With this in view, a deliberate change has, therefore, to be made in the system of education.

The nature of the transformation required in the educational system is generally recognised but the urgency for it does not seem to have been felt. *This much needed transformation has to be brought about as early as possible, as otherwise the difficulty and the cost of bringing about the change in the character of the educational system at a later date would become very great*, as, in the meanwhile, rapid expansion of education would be taking place. It was, therefore, felt by the Education Commission (1964-66), that "no reform is more important or more urgent than to transform education, to endeavour to relate it to life, needs and aspiration of the people and thereby make it a powerful instrument of social, economic and cultural transformation necessary for the realisation of our national goals."

According to the Education Commission the direct link between

education, life and productivity can be forged by having science as a basic component of education and culture; work-experience as an integral part of general education; vocationalisation of education especially at the secondary school level.

The Commission suggested that:

—work-experience should be introduced as an integral part of education at all school stages.

—work-experience should be used as a progressive teaching method for education.

—work-experience should be forward-looking, in keeping with the technological age.

—work-experience should also include participation in some form of productive work under conditions, of real production situation in schools, in homes, in workshops, on farms, in factories or in any other productive situation.

—work-experience should give some monetary return to the students.

Thus, the term, "Work-experience" was introduced to connote a 'new' curriculum area in the education system. Work-experience programmes are to be integral part of *general education* at all stages with the specific purpose of relating education closely to life and productivity.

Part of General Education

It is necessary to stress that work-experience has been recommended by the Education Commission to be introduced as a curriculum area in schools at all stages as a part of *general education.*

General education relates to the common concerns, experiences and backgrounds of all "educated persons". Courses in this area are to be designed so as to result in the improvement of the individual's ability to live well and wisely as a good and competent citizen. An individual is equipped with this ability if he understands and appreciates his relations with his fellowmen, the world around him, the achievements of man up to this day and his own potentialities and actions. Thus, general education would develop

in the individuals some universal abilities which would be of help in performing particular tasks. General education courses will broaden the student's vista so as to help him to have a richer and more creative life for himself.

Education Commission opined that all good and purposeful education should consist of at least four basic elements:

Literacy or a study of languages, humanities and social sciences.

—Numeracy or a study of mathematics and natural sciences;

—Work-experience;

—Social service.

The world of technological work is related to production based on science and technology. The man made world is getting more and more complex now-a-days and it requires special preparation for living intelligently in such a society. The programme of 'literacy helps in understanding the social environment and develop desirable social behaviour. The programme of 'Numeracy' helps in understanding the laws of nature and its use for improving the human life. Work-experience helps in developing an intelligent appreciation of the technological world and participating efficiently in the process of production. Through this programme students will learn not only about materials and processes but the role of work in improving the living conditions.

Need for Work-experience Programmes

We have seen how a study of the world of technological work is necessary as a part of general education in India today. It is necessary to consider here as to why a study of the world of work has become necessary now while it was not so considered earlier.

There was a time when most homes prepared most of the things they used. Transportation was limited. Trade was restricted to local dealings of hand made articles. The villages, if not the households, were the complete producers as well as the consumers of common necessities. The things have changed now. Human abilities, and improved materials, tools and processes of production have played an important part in bringing about this change These are

the important components of the technological part of the society in the direction of which India is moving today.

In the past generations, the important handicraft abilities were transmitted from the father to son and from the mother to daughter; but the rapid change in the manner and mode of living makes it necessary to look outside the family for such experiences. As in other cases, society has to turn to school for providing this type of learning experiences. In the earlier years, the independent craftsman was quite self-supporting and his product also was entirely his own performance. But now there is division of labour and "work" today has assumed a social character in production. In this swiftly changing method of production, now each individual should be able to assume, his own function in the production process.

The well-being of man rests increasingly on the various technological means of production. He, therefore, needs a kind of education (providing him with understanding and skill) corresponding to the stage of development.

In the technological age, centralised production takes place away from the immediate vicinity of the home. Earlier, everyone had the opportunity to watch the production processes at close range and to participate in them. Now such observation and participation is no longer possible. This shortcoming has to be compensated by the school.

The environment also as it is emerging will be made of sophisticated technology and its complicated and complex creations. So a curriculum area has become necessary in schools to enable pupils to understand and appreciate this environment. The world of work is becoming increasingly more technical in nature, more complex in organisation and more pervasive in its effects on society. In the emerging industrial, science-based technological society, there will be a wide gap in the general education of our pupils, without work-experience as envisaged above. Thus, it should be very clear that work-experience does not mean teaching of a trade or a craft but it is aimed at developing a mode of life.

As India of tomorrow will have increased mechanisation, so the need for work-experience programmes as a part of general education will increase.

Programmes in Operation Today

Many and varied types of programmes have been introduced and are being implemented in several schools in various states, in the curricular area of work-experience. Various nomenclatures have also been used to characterise these programmes—"Earn while you Learn Scheme", "Air Vice-Marshal Scheme", "Occupation-oriented Programme", "The Job and Hobby-oriented Programme", etc.

These and similar programmes operating today do contain within themselves some aspects of a good work-experience programme. These programmes appear to highlight only a few aspects, ignoring many important features in the process, thus presenting a distorted picture of the programme. It is not desirable to have various terminologies to denote even one type of programme. It becomes still more confusing at the grass roots level, if several nomenclatures are simultaneously used by different field workers to denote various types of programmes, when all are said to be work-experience programmes. It is, therefore, in the interests of easy communication among the workers that the use of different terms be avoided. It is also necessary for the programmes not to focus only on some aspects while ignoring other aspects, which may be the unique aspects.

Many field workers also regard the work done in the science clubs or the practical work in connection with any school subject as work-experience. Some States seem to have started work-experience programmes by just declaring their on-going programmes of crafts, agriculture, etc., to be work-experience programmes.

It has also been observed during the implementation of some programmes that:

—they are being offered only to those who are interested and not for all students;
—they sometimes reduce themselves to the traditional craft work, (3 times a week, one period each);
—they relate all activities by the students only to products;
—they emphasise the monetary return aspect to the total detriment of others;
—they virtually become just social service deeds;
—they are simultaneously introduced for all classes in a

school, say for Classes 5 to 10, and that too in one area.

The foregoing offers some evidence that the basic purpose of work-experience as "Curriculum offerings in all stages of education, as an integral part of general educaton, with the view of familiarising the students with the world of technological work around them, though experiencing representative samples of production processes" has not been completely understood and appreciated by workers in the field.

It is better not to carry with us the connotations of the seemingly similar past programmes, with implications that may mislead and distort the aims and character of the objectives of the programmes in those institutions and classes where they are not opevailing programmes to reflect the proper concept of work-experience. An additional task would be the introduction of the programmes in those institutions and classes where they are not operating at present.

Main Features of the Programmes

Work-experience has to be a part of the learning experiences of *all* students at *all levels of grade and ability.* It should be clearly understood that in order to achieve the desired objectives, ample and varied opportunities of different types of experiences concerned with developing insights into the broad aspects of technological work have to be provided at various levels of grade to suit the ability and the maturity of the students at these levels, so that they develop increasing understanding of their industrial-technological environment and are able to control it.

Work-experience programmes contribute uniquely to the development of the students who may leave the school early and those who continue their education further, viz., pupils with low scholastic ability as well as those who have high academic aptitude, pupils who may in future become semi-skilled or skilled workers or those who may become future technical or professional people in any area of human endeavour (not necessarily related to technology), pupils who come from comparatively low socio-economic back-

ground or rural setting, or those enjoying higher socio-economic status or coming from metropolitan areas. All these pupils have to live naturally in tomorrow's society which will be highly technological in nature and hence have to understand the same and be in a position to shape the same as per the values of the day.

The content of work-experience deals with the understanding of principles and development of concepts of the technological work-processes performed on materials, energy and information. It includes the systematic study of such principles as application of mechanism, influence of mass production and automation, creation of new ideas and products.

Experiences should cover a wide range all the way from the simple paper and card board articles, to the more exacting demands of machine tools and electronics.

An awareness of the world of technological work and its role in Indian culture is to be fostered. Awareness in an educated person cannot be just superficial. It will lead him to action.

The methodology to be adopted is naturally derived from the objectives. It is the actual involvement of the students with tools and machines for processing materials, energy and information.

It is necessary to record here that what is aimed at is not an academic study of the world of technological work, but a practical understanding of it through active and actual participation in performance of production processes. The performance of processes done in the school situation should be consciously related to those that are done in the actual world of technological work. It should not be assumed that if a pupil carries out some process in the school, he develops a realistic understanding of the world of work.

Problem-solving and self-expression in an environment relating to technological work are desirable special features. This actual involement and direct experiences enables students to gain insight into the application of these same principles in modern production methods. At the same time, pupils use and develop rational and creative abilities through which they come to know themselves better.

Wholesome changes in pupils, desired by society and sought by the school, are brought about by this curricular area. These changes relate to the attitudes towards work, and one's environ-

ment, and values regarding the use of public property, avoidance of wastage and economic growth. Students derive meaning from concrete experiences which aid in the understanding of abstract ideas. These activities will assist the learners to discover themselves, and develop their talents and abilities.

The experiences do certainly develop in the students some amount of elementary level technical competence in a variety of basic mechanical skills. But it is to be stressed that the development of "manual dexterity" aspect of technical skill at the expense of "technological comprehension" is not the aim of work-experience programmes. Students have also to be helped to realise that "technological work" is the source of our material goods and national wealth and the bulwark of our standard of living. From what has been stated, work-experience contributes to the general education objectives of the school along with other curricular areas. But it makes one important and distinct contribution which no other area can claim to make. Its unique contribution lies in developing in students insights into the technological work going on in the science-based technical society of which he is to become an intelligent member.

For the sound implementation of the work-experience programmes, it is necessary to state clearly and categorically at this stage the general objectives of work-experience:

1. To enable the learners to develop an understanding of the underlying principles and the basic practices of the emerging world of technological work.
2. To enable the students to develop a practical and realistic understanding of the means (tools, machines, etc.), media (materials, energy, information), measures (processes, management) of the world of technological work as it strives to fulfil a specific need of society, and to motivate them to adopting technological work.
3. To enable the learners to develop some reasonable degree of basic mechanical skills and technical competency in the matching of the means, media, measure and motive.
4. To enable the learners develop the desirable personal and social traits.

In view of its special opportunities, in terms of substance and

didactics, for training the educating children work-experience contributes to the overcoming of the barrier between the world of studies and the world of labour.

Knowledge of real production processes, which is acquired in the course of these lessons, will make it easier for children to choose career and pass into working life. Early habituation to practical, socially useful work will help them acquire a new mental attitude towards productive work and working people and they will understand production of material goods as the source of social wealth.

The specific objectives of the programme are:

- —elementary knowledge of the structure of raw materials (wood; metal; leather; plastic; glue, etc.). their specifications, their method of identification, process of their manufacture, their physical, chemical and mechanical proprcties.
- —elementary knowledge of the structure of the means of production (tools, spinning wheel, loom, file scissor, borer...) their parts and their construction;
- —elementary skills in mental and physical work for productive activities according to the local conditions and requirements;
- —elementary knowledge of cost of production and marketing;
- —a sense of dignity of labour, of self-reliance, spirit of enterprise and of discipline;
- —interest in locating problems and finding solutions to them thereby raising the productive capacity of the nation.

Manual work is done in close interaction with intellectual activities and can therefore contribute to the process of learning being intensified.

Monetary Returns

It has been stressed over and over again that the work-experience area is an integral part of the general education programme of the school, like the languages, or science. It is true that the cost of organising humanities programme would be considerably less than

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 1, January 1973

that of a science programme, and the cost of running a work-experience programme will be greater than that of science.

But the issue of monetary return is not generally raised in relation to the area of science, as it has by now attained respectability as a general education course. Work-experience is yet to acquire this status and the unconscious mental reservations about considering work-experience programme as an integral part of general education manifests itself in the form of the 'monetary returns' question. Somehow the term work smacks of vocational flavour.

But strangely enough this issue is not evident in connection with vocational education programmes actually operating in the country. The programmes have been truely recognised as "education programmes" and this aspect is not given undue importance. Stress is rightly laid on the educational and not the economic aspect. When such is the case with vocational programmes, this economic aspect should not be regarded as important at all, in the case of general education programmes like work-experience.

If, unfortunately, undue stress is laid on this aspect, the general education character of the programme would suffer. It may in actual practice be reduced to simple manual dexterity in some cases or just observation or peripheral participation in production situations, the actual operation being done by technicians.

The initial cost and the running expenditure of work-experience programme are indeed high but the return on the investment is equally great. Education is a long-range investment and a good education is both a condition and a stimulant for economic development.

Secondary Benefits

An important feature of any healthy educational system is the encouragement it offers to each individual learner to obtain *all* the education he *can*. But the enormous wastage and stagnation that is observed in our school system today, may in part be due to the present "school culture", as it places great emphasis on word-ability, speed and one "style of learning". Students coming from some segments of our society are likely to have 'physical style' or other styles of learning than the one that the school insists. It is,

therefore, necessary that the schools should encourage 'pluralistic styles of learning'. It is in this respect that the programmes of work-experience can be of great use. The considerable wastage and stagnation, noticed in the primary stage of education may be drastically reduced, if there are proper type of work-experience programmes at that stage, which in addition to achieving the central objectives can also provide to the learners:

—creative experiences lending interest to other subjects;
—enrichment of instruction in other fields with increased meaning and understanding;
—assistance by making concepts more concrete by reducing the level of abstraction;
—opportunity to develop ability to think rationally at their own level.

Thus it can act as a means for the integrated activity programmes.

The tendency in the years to come will be for an increase in the number of students entering the school system and continuing in the school system with sub-standard attainments and with very limited home background (particularly the first generation of learners). Narrow academic fields only cannot help pupils from this sector of our population. We can ill afford to have our youngsters leave the schools without some practical awareness and understanding of the world of work. But unfortunately this is what is happening now, both at the primary and at the secondary levels for the drop-outs as well as the school leavers. We cannot allow our youngsters to leave the school system with the range of their talents unexplored, unguided and undeveloped. The present school system is doing just *This*. General occupation readiness is desirable for those who drop-out of the school in the primary stage and some pre-vocational and exploratory experiences are required for those who leave the primary school for the world of work or for vocational schools.

Work-experience programme will satisfy the need of the learners for activities, would reinforce learning in other subject areas of the curricula, satisfy the urge for creative expression, provide a feeling of success with a desirable pride and pleasure of accomplishment, develop better personalities, develop self-assurance and

confidence, satisfy the desire to do worthwhile things and help the learners to think rationally in terms of concrete materials.

The image of the school will be changed by the proper implementation of the work-experience programme and the "achievement motivation" of the learner will definitely be improved. It is then possible to enrol more students of the school-going age into the school, hold them in the school and give them a feeling of success in their studies. The several surveys conducted point out in no uncertain terms that drop-out and failures are not entirely due to the lack of ability but rather due to lack of motivation, lack of confidence, absence of good study and working habits, etc.

It is also recognised that the needs of our society in the near future will call for talents on a scale, of a range and at a level not available today. This implies that there should be more opportunities for education of children designed to attract, to hold and to educate large numbers of people at all levels of competence in *all* the areas.

According to Tyler, "a bridge should be built between the world of sense experiences and the effective use of thought to understand and extend the direct experience we have of the world through our senses. Mind serves to organise and interpret what we experience directly. Words and thoughts unrelated to an experienced reality are phantom images and undisciplined dreams. Direct experience that is not reflected upon, explored in imagination, tested by comparison with other experiences has little meaning. Education is responsible to keep these developments in relation to each other."

Work-experience programme is in a happy position to take upon itself this responsibility.

Diversion of students at the end of the primary and also at the end of the secondary stage to vocational-technical types of courses has been recommended by Education Commission.

By providing work-experience programmes, to the students earlier, many experiences in several areas would have given the students opportunities to try-out and discover for themselves their area of interest and aptitude. Guidance work would also be facilitated by the data available. The right type of people who have a great chance of success at the vocational course would be diverted.

This would ensure the success of the vocational programmes. Further, as many entrants would have had some elementary degree of technical skill and would have developed "general occupational readiness", depending on the point of diversion, the vocational courses could have richer curriculum, so that the level of attainment of the students at the end of their vocational technical type of courses can be higher than they are at present.

Thus work-experience programme contributes in a large measure to the qualitative improvement of education. It will also help in the realisation of our aim of equality of educational opportunity for all.

Guidelines for the Curriculum

The objective of work-experience programmes at the lower primary stage of education is to help the children to change gradually from play to learning to do elementary types of work. During work they will be assisted to explore the materials they work on and the tools they make use of, and also to appreciate the nature of organisation required for the performance. Emphasis on the productive aspect cannot be laid at this stage. At the same time stress should be laid upon the careful use of the materials, for the purposes they have to serve. Considering the physical development and maturity of the students at this stage, the materials they have to work on should be plastic and pliable. The areas of work would be modelling, clay work, simple gardening, paper and card-board work. It is also necessary to ensure that the students use skillfully simple tools, like scissors, files, hammers, screw-drivers. This will imply that they should be assisted to think clearly the intended purpose and skillful control of the results of performance.

From the foregoing it would be seen that the objectives stressed during the lower primary stage are related to the understanding of the means, media and measures of technical work besides development of basic skills and desirable personal and social traits.

The upper primary stage is the transitory one from the orientation and exploratory character to the productive one.

In the performance of work at this stage, precision and

quality both during the process of performance and at the final product of peformance will have to be stressed. Mental ability of the children at this stage is a little higher and understanding of the basic principles underlying technological practices could be emphasised to some reasonable degree. The objective related to understanding of the underlying principles and the basic practices of the emerging world of technological work should be kept in view.

The nature and number of technological skills will still be limited and hence the number of tools and nature of operations performed by the students will also be restricted. As the students grow physically the media used may be a little more rigid. That means wood, metal, leather, etc., would also be made use of In addition to manipulative skills in relation to wood, metal, etc., the students should be helped to develop understanding of certain mechanisms commonly made use of in various machines and appliances that are familiar to the students in their immediate technological environment.

At the secondary stage the students may be given the option of exploring in depth one of the several areas they have already explored. This would mean concentration of their efforts and study in a particular area. This can provide for some students, instruction that could prove to be a remote preparation for a vocation. Earlier, exploratory experiences would have provided for many students opportunities to make a very tentative and preliminary choice of a future vocation they may take up. Depending upon the person's ability, the level at which he would operate in the occupation of his choice could also be different, viz., skilled worker, technician or a professional. This type of instruction is sometimes referred to as "Pre-vocational preparation". So the final two years of instruction at the secondary stage would be "Pre-vocational in character", while instruction in the previous grades would serve the function of orientation, exploration and technological skill development.

At the several stages of instruction referred to earlier, stress should be continuously laid on the objective related to helping the students to develop the desirable personal social traits.

It may also be observed from the above that the scope of the curriculum has been derived from the social functions approach but the sequence has necessarily to take into account the needs and

ability of the students at a given level of grade and age. Centres of interest for each grade have also to be charted.

Specific objectives have to be spelled out in some detail taking both the content and the behaviour aspects. Clear-cut learning outcomes have to be catalogued. This would facilitate the design and planning of suitable learning experiences and also the appropriate tools of evaluation. The intended behavioural changes relate to all the three domains—cognitive, affective and psycho-motor.

To sum up, it may be said that work-experience programme:

—contributes uniquely to the development of the understanding of the world of technological work through active participation;

—leads to the development of some competency in the performance of technological work;

—fosters the development of socially desirable habits and proper attitudes;

—provides opportunities that result in consumer literacy;

—serves as a sound basis for vocational guidance;

—promotes satisfying leisure-time interests;

—offers unlimited scope for the reinforcement of learning in other areas.

In short, it contributes in its own distinct way to the all round and well-balanced development of an individual, as a member of the human society.

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Application of Manpower Requirement Approach to Educational Planning

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Four approaches, simple correlation, residual, returns to education and manpower forecasting relate education to the economy. The basic methods applied in the manpower forecasting approach are detailed and the transformation of manpower targets into enrolment targets for education is described. Modifications necessitated by cultural requirements, wastage in the educational system, etc., are listed. It is also noted that the approach has inherent difficulties such as the change in manpower requirements on account of change in technology, changing equivalence between jobs and education, etc.

Recent studies in the field of economics of education show that changes over time in the inputs of labour and capital stock do not

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wholly explain the changes in output and in fact leave a substantial portion of economic growth unaccounted for. This phenomenon has been explained by introducing the concept of what is called "residual" or "third" factor of growth in a formal input-output relation.[1] Using the Cobb-Douglas function as an example the new relationship between the factors of production is said to be of the following type:

$$O = AL^{\alpha} \quad K^{1-\alpha} \quad \varepsilon^{rt}$$

where O=Output, L=Labour Input, K=Capital stock and r=residual. A significant element of the residual is presumed to be education. It has now been amply demonstrated that human skills are among the important factors in production and that economic development should be accompanied by accumulation of trained manpower in sufficient quantities.

The educational system is interlocked functionally with the socio-economic environment. The expansion of education is linked basically to the employment situation, since the educated youths expect to earn a living commensurate with their educational qualifications. As the educational industry consumes a large portion of the national budget, education systems are dependent upon the fiscal systems within which they operate. We have, therefore, to integrate educational planning with overall planning so that we neither have the problems of educated unemployed on the one hand nor the shortage of trained persons on the other.

Manpower Requirement Approach

A number of conflicting and complementary approaches (econo-

[1]T.W. Schultz "Capital Formation by Education", *Journal of Political Economy*, Vol. LXVIII, No. 6, 1960. Also H.M. Phillips "Education as a Basic Factor in Economic and Social Development". *Final Report of Conference of African States on the Development of Education in Africa*, Addis Ababa, May 1961. Prof. Harbison has consistently advocated this theme in almost all his writings. Prof. Schultz's monograph *The Economic Value of Education*' Colombia University Press, New York, 1963 and Prof. John Vaizey's book, *The Economics of Education*, Faber and Faber, London, 1962, contain valuable discussions of the role of education in economic growth. Recently the Unesco has published a selection of articles, "Essays and Texts from the Works of Economists, Past and Present" in *Readings in the Economics of Education*, 1968.

mic, social, cultural) are available in the field of educational planning and, within the economic, we have as many as four approaches, viz:

1. The simple correlation approach;
2. The residual approach;
3. The returns to education approach; and
4. The manpower forecasting approach.

Manpower requirement approach has been elaborated by various authors in a number of ways. However, a fine example of the application of the manpower requirement approach is provided by the Organisation for Economic Cooperation and Development (OECD) in their study of six countries of the Mediterranean Regional Project. The OECD in this area concentrated on the elaboration of manpower objectives to be met by the educational system. A study of the manpower requirement approach applied by the OECD provides a number of systematic steps which have to be taken for translating economic goals into educational out-turns. These steps are listed below in a chronological order:

(a) As the logic of the manpower requirement approach is to link the targets of educational system to those of the economic system, the starting point is the availability or the establishment of a target figure of the Gross Domestic Product (GDP) or of Gross National Product (GNP) of a country 10 to 15 years hence. This target is generally laid down in the economic plan of the country and the educational planner is, therefore, confronted with the problem to project the number of educated people that should be available over the time span of this economic plan to realise the target for the GDP or the GNP In other words, he is called upon to translate the GDP or GNP targets into an education output target.

(b) The second step is to break the GDP or GNP target for the whole economy into targets of individual sectors of the economy such as agriculture, mining, manufacturing, transportation, communication, etc.

(c) These sectoral outputs are then multiplied by labour coefficients to arrive at an estimate of the number of workérs required to produce output for each sector.

(d) Next, the occupational structure of the labour force within each sector is projected and in order to convert the occupational estimates into the educational composition of the labour force, estimates must be developed of the kinds of education which are to be associated with each occupational category. This is done by means of an occupational classification of the labour force.

(e) After identifying various occupations an estimate is formed of the minimum level of formal education that is considered essential to carry out an occupational task.*

(f) The next task is to convert the projected target educational stock into flow estimates of educational system. The education flow estimates are arrived at by subtracting from the target stock those in the base year, after making allowance for births, retirement, death, etc., (known in the manpower jargon as "attrition"). This exercise should be done for each educational category separately so that we can have a clear estimate of the increment of manpower by educational category which will be necessary to add to the labour force over the projected period.

(g) Finally, since some of the graduates of the educational system do not enter the labour force, the increment of manpower by educational category should be multiplied by estimates of the inverse of labour force participation rates of such graduates. Now the resulting figure will

*The conversion of occupational requirements into educational requirements is one of the most perplexing problems in manpower analysis. Except in the case of a few occupations, there is no precise relationship between occupational and educational back-ground. Actually in many cases the supply of educated manpower determines in part the demand also. The assumptions about the relationship of occupations to educational levels will differ from country to country and in one country itself at different points of time. For example, an advanced country may absorb more highly educated persons in similar occupations than an underdeveloped country. As such the manpower planners may rely on judgment rather than on precise data. It is, however, neither necessary nor desirable to estimate needs in this way for a large number of specialised occupations because in dynamic economies there is a great amount of movement from one occupation to another and the needs for specialised skills are apt to fluctuate sharply.

represent the final estimate of the required total flow of graduates by level and type of education over the projected period. This figure will be important for our educational programmes as this will form the basis for our enrolment policies at various levels and types of education after making adjustments for factors like

(i) duration of the course;
(ii) wastage in the educational system;
(iii) transition rates from one stage to another;
(iv) role of informal education and training.

Sometimes the projection of the occupational structure is omitted and instead we go directly to the educational structure of the labour force. This is, for example, a feature of the Tinbergen[1] model and is also proposed by G. Bombech,[2] although the latter seems to do so only because he thinks that data on the occupational structure are harder to come by than data on the educational structure. This, however, does not hold true now in most countries. The OECD has recently provided and compared the occupational and educational structures of the labour force in 53 countries.[4] As such, wherever data on occupational structure of the labour force are available, it will be advisable not to omit the classification of labour force by occupations.

The main objective of a manpower projection is to determine in broad terms the adjustments required in the educational process for producing the right number of requisite trained personnel at the right time. It takes years to build trained manpower resources as education consists of a succession of processes each taking a considerable time. The long time lag in equipping a person adequately for a job through education and training dictates the need for advance action. The long term targets for educational expansion also provide the basis for quantitative conclusion about the growth

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[1]J. Tinbergen and H.C., Bos. *et. al, Econometric Models of Education*, OECD, Paris, 1965.

[2]G. Bombech, '*Forecasting Requirements for qualified Manpower as a Basis for Education Policy*, a Manpower Forecast in Education Planning, OECD, Paris, 1967.

[4]*Occupational and Educational Structure of the Labour Force and Levels of Economic Development*, OECD, Paris, 1970.

of expenditure as well as indicate the balance that must be sought between the several levels of education (higher, secondary and primary), changes in structure and curriculum. Thus for example, the targets elaborated within the Mediterranean Regional Project indicated the priority that must be given to the development of secondary education, and within that to secondary technical education, in those countries.

TRANSLATION OF MANPOWER TARGETS INTO ENROLMENT TARGETS

Net and Gross Demand

So far our discussion has confined to reach the number of people with different educational qualifications for the projected *occupational* categories worked out either on the basis of some growth rate of GNP or target figures of investment, etc. These numbers of educated persons, though they represent a major portion of the total demand of graduates, cannot form a complete basis for the expansion of educational facilities. They represent only *net* demand while the expansion of education is influenced by gross demand for educated persons. For arriving at the gross demand for educated persons the net demand worked out by the manpower planners has to be inflated to take care of the following phenomena:

(i) *Participation rate.* All educated people do not necessarily work. Some remain students, some house-wives and still some remain unemployed or voluntarily out of labour force. The question, therefore, is what total stock will be like in the future if the needs for educated workers are to be supplied. In other words, at what rate should cohort out-turns be inflated to provide the desired stocks of educated persons? This question requires some assumption to be made with regard to participation rates of educated people in general and participation rates of cohort out-turns in particular. The participation rates are influenced by factors like facilities for further and higher education, economic status of the people, social-cultural traditions of female participation in economic activities, etc. As far as the question of students re-enrolment is concerned it is not very difficult as it can be estimated on the

basis of past trends. The number of educated house-wives may be found to be closely related to the supply of educated women. It is further difficult to forecast as to what proportion of educated women in future will prefer to be house-wives and what proportion will go out of work. This will of course partly depend on the relative supply of and demand for educated persons in general. The Education Commission assumed a constant proportion of educated women in their forecast of educated workers.* In a country as large as India there is bound to be some frictional unemployment among the educated persons. Unemployment among educated persons has, however, become a very serious problem today in the country and represents a sizeable proportion of the total stock of educated persons. It is difficult to indicate the proportion it will form in future.

(ii) *Social-cultural component.* The manpower requirements do not provide the full and complete basis for educational expansion. Some education has to be provided for social and cultural considerations. Therefore, while planning for enrolments and the educational facilities, allowance should be made for social cultural demand component also.

(iii) *Migration-Brain Drain*: Though an insignificant portion of the total educational out-turn, significant portions of some particular branches of specialisations may migrate out resulting in requirement for higher enrolments. The out-migration of doctors, highly qualified engineers and physicists from India, for instance, leaves a reduced number of qualified persons for her economic development.

(iv) *Inter-occupational mobility.* Occupational mobility is very common in the economic world today. If this mobility is within the occupations requiring same educational preparations it will not affect our calculations. However, if the occupational mobility crosses with the educational preparations adjustments will also have to be made on this account.

**Report of the Education Commission*, 1964-66, page 95. A constant proportion was also assumed by Burgess, Layard and Pant in *Manpower and Educational Development in India* 1961-1986, Oliver and Boyd, Edinburgh and London, 1968, p. 19.

(v) *Teachers requirement.* Sometimes manpower forecast do not provide required number of teachers. In such situations these requirements can be estimated on the basis of assumed pupil-teacher ratios at different levels and in various branches of the educational system. Sometimes the expansion of enrolment at the several levels of the educational system may be affected by the current and prospective supply of teaching personnel. On the other hand, expansion of education at subsequent levels depends on the adequate graduations at earlier levels. For example, university enrolment can be significantly expanded if only there has been an increase in the number of higher secondary graduates but the additional teachers required for the expansion of the secondary schools must come from university graduates. This suggests that the indicated increases in the enrolment at the secondary level should either be postponed or at least reduced until teachers supply can be increased through expansion of university enrolment. Thus, we see a logistic problem in planning the expansion of enrolment at several levels of educational system.[8]

(vi) *System of education.* While relating the out-turn of graduates to the respective total enrolments which lead up to it, the system of education should also be kept in mind. Particularly relevant in this context is the length of courses. In some states of India, the Secondary School Education runs for 11 years, followed by a 3-year course for graduation while in others it takes only 10 years to complete the secondary education. It will be better in our conditions that these calculations should be made separately for each state and then added up in an all India total.

(vii) *Other considerations.* After having arrived at *required* enrolment in the various levels and branches of educational system on the basis of *manpower requirement approach* and adding to it the enrolment for social and cultural considerations the job of educational planners is to translate these into actual investment targets. He will be faced with the problems of knowing how many new schools have to be built, to what extent facilities need to be extended and/or modified, how much new equipment may be

[8]Parnes, *H.S., Forecasting Educational Needs for Economic and Social Development,* OECD, 1962, p. 61.

required, what personnel other than teachers will be required and above all how much of all this is going to cost. These steps are the same of course, whether the required enrolments are based on the *manpower or* the *cultural* approach.

When account has been taken of the above mentioned factors the transformation of gross demand of educated persons into the enrolment of educational system will be a simpler process. It will be a direct input-output exercise affected by only internal leakages in the form of educational wastage.

Estimating Enrolments

Once the numbers of required graduates (gross) for each level are arrived at, it is necessary to convert these figures into annual out-turns and to calculate either the total enrolments or the additional enrolments that they imply. There are several scheduling problems that need to be kept in mind in this phase of the work. For example, it is difficult to spread the required number of graduates evenly over the forecast period because it takes some time for the necessary school facilities to be planned and constructed. Secondly, the duration of the course has to be taken into account because the out-turn will lag behind by the number of years the course is spread over. Finally, a proper balance has to be maintained among the several levels of the educational system. (We cannot have more university graduates if our secondary school system has not already expanded. Similarly, significant expansion in earlier phase will be necessary at the elementary level.) It is actually this final objective in the process of projecting manpower requirements that influences the educational system. In translating the manpower requirements into educational enrolment at the various levels the considerations regarding wastage and stagnation require specific treatment.

The relationship between the total enrolment and the required number of graduates depends on wastage in the courses of study and on the average length of attendance allowing for pupils who repeat. An important question here may be how to treat drop-outs and failures. It may be asked whether only those who qualify after a course of study or all the pupils who finish the last year should

be taken into account. In the developing countries or in cases of shortages of qualified persons all those who reach the last year of the course may presumably qualify to take a job at the corresponding level of qualifications.[7] To the annual flow of those qualifying after the course of the study should be added pupils who have dropped out during the advanced part.

Within the education process, the relationship between output (graduates passing out a course) and input (intake or enrolment) can be explained by the extent of wastage—dropouts and repetition. Wastage results in two streams of students: regulars and repeaters. If the course is of three years duration, the regular students complete it in three years while the repeaters take more than three years. Hence, there does not exist a simple relationship between the admission at the beginning of the course and the out-turn at the end of the course. For example, amongst the current year's out-turn there will be a number of persons who were not admitted at the beginning of the current course but earlier.

We consider below a three-year course and examine the transition process by looking into the structure of students at any point of time. We take 1975 as the reference year and classify the student body in four categories as follows:

(i) enrolment in the first year;
(ii) enrolment in the second year;
(iii) enrolment in the third year;
(iv) the out-turn in the year 1975.

Based on the above considerations the fresh admissions (intake) of a three-year course yielding a given out-turn, say in year 1975 can be estimated by the following formula:

$$y(75)=x(72)p_1p_2p_3+x(71)p_1p_2p_3\ [(1-p_1)q_1+(1-p_2)q_2+(1-p_3)q_3]^*$$

[7]Debeauvais, "Methods of Forecasting Long-term Manpower Needs" *Planning Education for Economic and Social Development*, OECD, Paris, p. 95.

*Readmission of students in a particular course year after a lapse of more than one year on failing to get promotion to next course year is assumed not to be significant. Secondly, fresh admissions are assumed to be in the first year of the course only. The above relations can be explained in the following ways:

(*Continued on next page*)

where:

y=Out-turn

x=Fresh admissions

$p_1 p_2$ and p_3=Fractions of students passing in the first second and the third years respectively

$q_1 q_2$ and q_3=readmissions, in fractions, of the plucked students in the three years respectively.

The formula can be generalised to cover courses of any duration as follows:

$$y(T)=x(T-n)p_1p_2 \ldots p_n+x(T-n-1)p_1p_2 \ldots p_n \left[\Sigma(1-p_i)q_i\right] \quad i=1,\ldots n$$

where:

n=length of the course in years

T=the calender year

The P's are estimated as per cent of the number of students passed to total students enrolled in the various course years. Currently, this information is available for the *Final* year examination in each course with the Ministry of Education. For the other course years these are not compiled. This information has to be collected for all course years. Similarly, the information about re-admission in the various course years, the Q's, is also not compiled. The data on these will also have to be collected. The P's and Q's are assumed to remain constant during the plan period. It is accordingly advisable to estimate the P's and Q's as averages for at least five years.

When the manpower targets have been worked out in terms of *gross* educational out-turns, it is very simple to determine the corresponding fresh admissions for various courses with the help of the above formula. To illustrate the method, we give below two estimates of *gross* educational out-turns for the period 1975 to 1980. One of the two estimates relates to a 8-year course and the other to a 5-year course.

(Continued from previous page)

$$E_3(75)=E_2(74)p_2+E_3(74)\,(1-p_3)q_3$$
$$E_2(75)=E_1(74)p_1+E_2(74)\,(1-p_2)q_2$$
$$E_1(75=x_1(75)+E_1(74)\,(1-p_1)q_1$$
$$y(75)=E_3(74)p_3$$

Where:- E= Enrolment

Targets of Gross Educational Out-turn

Year	*3-Year Course*	*5-Year Course*
1975	1000	500
1976	1200	550
1977	1400	600
1978	1600	650
1979	1800	700
1980	2000	750

The assumed pass and re-admission percentages for the two courses may be taken as follows:

3-Year Course	$\frac{p_1}{80}$	$\frac{p_2}{75}$	$\frac{p_3}{70}$			$\frac{q_1}{60}$	$\frac{q_2}{75}$	$\frac{q_3}{85}$		
5-Year Course	$\frac{p_1}{95}$	$\frac{p_2}{90}$	$\frac{p_3}{85}$	$\frac{p_4}{80}$	$\frac{p_5}{75}$	$\frac{q_1}{45}$	$\frac{q_2}{60}$	$\frac{q_3}{55}$	$\frac{q_4}{85}$	$\frac{q_5}{95}$

As the estimates of gross educational out-turn have to be worked out for the period beginning the year 1975, data on fresh admissions for the two courses for the years 1971 (for the 3-year course) and for the year 1969 (for the 5-year course) will be required and these should be available. Let us take them as 1,150 for the 3-year course (in 1971) and 650 for the 5-year course (in 1969).

On the basis of above data the formula provides the following estimated fresh admissions for the two courses:

Corresponding Estimated Fresh Admissions for the Planned Annual Out-turn for the Period 1975 to 1980

Year	*3-Year Course*	*5-Year Course*
1970	...	780
1971	...	823
1972	1575	913
1973	1760	977
1974	2105	1055
1975	2340	1126
1976	2652	...
1977	2912	...

Econometric Models

A number of econometric models have been developed in the field of manpower and education. These models are either of input-output type or they are based on transitional probabilities. The first comprehensive model was developed by H. Corea and Jan Tinbergen.[8] This model is quite simple and is of input-output type. This model has been subsequently refined by Tinbergen and H.C. Bos.[9] Besides these Tinbergenian Models, we have models developed by Professor Richard Stone,[10] Professor Tore Thonstad[11] and Professor C.A. Moser.[12] It will not be possible to discuss all these models here and we shall restrict our discussion to the presentation of Tinbergen models in brief.

The Tinbergen models deal with the quantitative side of some of the problems involved in adaption of education to economic growth. These models, as already stated, are of the input-output type in which all ordinary economic activity is fully aggregated and represented by production volume "V" and education activity by two sectors—those of secondary and third level education. The number of students in these two sectors are indicated by n^s and n^t, respectively, further variables are: N^s, the total stock in people with a secondary education N^t, those with a third level education; m^s those among the N^s who entered within the previous 6 years; and m^t those among the N^t who entered in the previous six years. The relationships assumed to exist between these variables are as follows:

$$(1)\ N^s_t = V^s U_t$$

[8]Corea, H. and Tinbergen, J. 'Quantitative Adaptation of Education to Accelerated Growth", *KYKLOS*, Vol. 15, No. 11, 1972.

[9]Tinbergen, J. and Bos, H.C. "A Planning Model for the Educational Requirements of Economic Development". *The Residual factor and Economic Growth*, OECD, Paris, 1964.

[10]Richard Stone, "Input-Output and Demographic Accounting: A Tool for Educational Planning," *Minerva*, Vol. IV, No. 3, Spring 1956.

[11]Tore Thonstad, *Education and Manpower: Theoretical Model and Emprical Applications*. Oliver and Boyd, Edinburgh and London, 1969.

[12]Moser, C.A. and Redfern, P. "Computable Model of the Educational System in England & Wales", *Bulletin of the 35th* (1965) *Session of the International Statistical Institute*, Belgrade, 1967. pp. 693-708.

$$(2)\ N^2_t = (1 - {}^2)\, N^2_{t-1} + m^2_t$$

$$(3)\ m^2_t = n^2_{t-1} - n^2_t$$

$$(4)\ m^3_t = n^3_{t-1}$$

$$(5)\ N^3_t = (1 - {}^3)\, N^3_{t-1} + m^3_t$$

$$(6)\ N^3_t = V^3 V_t + {}^2 n^2_t + {}^3 n^3_t$$

The values of the coefficients were derived from the United States experience. But they are meant only as indications of orders of magnitude. The authors have explained as how their model may take care of some of the basic educational phenomena like drop-out, increased number of educational stages/levels, surplus educated people, etc.

(i) *Drop-outs*: The basic model assumes that all students enrolled at secondary schools will one period later either join the labour force with secondary education or be enrolled in third level education. This is a simplified picture of the reality for (a) not all students enrolled will graduate. Some do not complete their studies, others fail their examination, (b) not all students will be able to complete their studies within the fixed time unit, i.e., the assumed training period for each level of education, and (c) not all second or third level graduates will join the labour force.

These factors can be taken into account by reformulating equations (3) and (4). In the reformulated equations the number of persons joining the labour force with secondary education will equal a fraction of the number of students enrolled at secondary schools one time period earlier. To this figure, will be added those third level students who do not complete their studies assumed to be numerically proportional to the number of third level students one time period earlier, minus those who complete their secondary education and continue their studies at the third level (re-enrolment cases). Similarly all the students enrolled at the third level education will not necessarily graduate and join the labour force.

(ii) *Increased number of educational processes.* For various purposes, it will be useful to distinguish between a larger number of education processes than the two assumed in the model. In the basic model, the first three equations refer to secondary and the next three to third level so that more stages of education will mean adding further triplets of equations, the manner of linking them together differing according to the type of educational sub-division chosen higher or lower level or spliting one level into parallel components. The authors have cited a very useful refinement with regard to third level education by splitting it into the humanities and technical and scientific subjects. The number of students entering these two branches have then been linked with the number of secondary school leavers by an equation replacing equation(3) as follows:—

$$m_t^2 = n_t^2 - n_t^3 - n_t^4$$

Where n_t^3 and n^4 now stand for the number of students in the humanities and science departments respectively.

(iii) *Surplus educated persons*: In some countries, as in India, the available labour force with a given level of education may surpass the needs of the economy for that particular type of manpower. This may be expressed by unemployment, under employment or low wages and may affect all graduates or only those in specific fields, e.g., law, arts, etc. According to the author, if the surplus is within the values of the solution, it may be eliminated in one time period otherwise a solution will be found assuming and adaptation period of two time units.

Concluding Remarks

The use of employment forecast to work out education|training programmes is extremely difficult. The main difficulty arises because there are very few occupations which can specifically be translated into skills (in terms of educational and training contents). A good example of occupational-educational relationship is provided by the medical sector. Nobody is allowed to practise medicine if he or she does not have the necessary educational/train-

ing qualifications and almost all qualified doctors (the men at least) practise their profession. Therefore, it is comparatively easy to calculate the demand for and supply of doctors for a given period in a given country. In this sector the linkage is further strengthened because the World Health Organisation has laid down carefully worked out standards in this connection. As all the doctors (practising) have to be registered with one and the same association, their age-group pyramid is easy to construct. Apart from this, rather an exceptional case, it is difficult to have such a clear and precise relationship among other occupations and skills. Some of the main difficulties which arise in the establishment of this relationship are listed below:

(i) The education and training received do not always tally with the career chosen. We have common examples of engineers employed as administrators.

(ii) Social mobility is another constraint. It is seen that many workers give up the career for which they are educated and trained at some stage because they do not like it or because they cannot earn enough or because living conditions do not suit them. In such occupations it will be necessary to work out the annual rate of drift.

(iii) Promotion also results many times in the change of an occupation without commensurate change in education. For example an engineer when promoted to administrative post occupies one for which specialist in administration should in the ordinary course qualify.

(iv) Some occupations can be performed by people possessing a variety of education/training qualifications, for example a foreman.

(v) The existing workforce when classified by occupation/education matrix may generally reveal that a preponderant portion does not possess adequate skills. This might have emerged due to the fact that when such people were employed there was an acute shortage of qualified people. In India we have another example of practical people who hold certain occupations by virtue of their association with the job rather than the acquisition of a particular type of education/training. A situation of this kind is very awkward when one has to plan for formal educational and training

courses, because there is the difficulty in ascertaining as to what will be the proportion of such persons in the coming years. It is equally difficult to assume correct proportion of promotion cases with diverse skills.

It would probably be very risky to translate the educational and training programmes too precisely on the basis of the present structure of occupations and future requirements for specific jobs. The difficulties are further aggravated because we do not have precise information and detailed statistics on either the occupational mix or educational contents of various jobs. As the educational cycle takes anything from 10 to 15 years, the educated and trained manpower in the year of forecast may become unsuitable if in the meanwhile the technology has changed.

Another limitation of the approach is that it leaves out of account provision for education as a "consumer good" and it makes no provision for social "minimum". The occupational needs of the country are not the whole of the society's need for education. For example, education has to be provided to women and girls who may not like to be gainfully employed. Similarly some education may be required to fulfil the national, social, cultural and political goals. Some account should also be taken of students' and parents' preferences, vocational disquilibrium demand and adjustments required by technological change.

The composition of the target "product mix" and of the investment programme undertaken to achieve it also depend in part on the relative cost of various educational programmes. This requires that that investment in education and in other sectors of development programmes should be mutually determined. The manpower approach, however, does not concern itself with the cost of education.

A further difficulty is the assumption that a given output requires a fixed volume of manpower with fixed amount and type of education and training. The fact is, however, that a certain latitude exists for substitution of capital for manpower in general and for substituting additional education and training for man hours.

The Education Commission (1964-66) had recommended that the provision of educational facilities in secondary and higher education could be related to the estimated manpower need only with

some reservation. It did not consider manpower forecasting a precise operation as it involved a large number of imponderables. It emphasised a continuous effort to improve the collection of data and the technique of forecasting. The Commission had also cautioned to the qualitative aspects of education which are generally lost sight of in translating manpower requirements into educational enrolments. It States:

> As manpower forecasts are ordinarily expressed in quantitative terms, the expansion of educational facilities tends to receive undue emphasis in translating them into enrolment terms. It is, therefore, essential to emphasize the quality of manpower produced because economic growth can be hindered rather than accelerated if appropriate standards are not maintained.[13]

Even after making allowance for the limitations listed above, manpower approach provide four broad indications in terms of magnitudes, e.g., the total enrolments needed, enrolments needed in different types of courses, shortages and surpluses in the manpower situation, and priorities involved. In the technical evaluation of the OECD's Mediterranean Regional Project R.G. Hollister also came to the conclusion that manpower requirements have a significant impact on educational output.[14] His analysis showed that in both projected MRP data for 1960-75 and in the historical data for 1951-61, over 50 per cent of the change in the required educational output was determined by manpower requirements. In the underdeveloped economies where technological changes are not very frequent, manpower requirement approach holds good for some time to come. However, much work remains to be done to improve the reliability and sophistication of manpower forecasting.

Assuming that one takes as a basis for educational planning long-term projections of labour inputs needed and taking into account the difficulty of making detailed projections and possible changes in the technology over the longer periods, multipurpose education

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[13]*Report of the Education Commission* (1964-66), p. 992.
[14]R.G. Hollister, "A Technical Evaluation of the OECD's Mediterrenian Regional Project: Methods and Conclusion," in *Educational Planning. The World Year Book of Education*, 1967, Evans Bros., Ltd., London.

and training is advisable. This will permit easy adoptation of skilled labour to unexpected changes in the future production structure.

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Examination and Evaluation in Science Education in India: A New Approach

R. M. Kalra
Matthew H. Bruce

Since Bloom's initial study of the examination system in India, studies and practical experience have further confirmed the need for adopting a new approach in evaluation. Evaluation requirements of proper system of science education lie in stressing other objectives than the achievement of the right answer alone. Necessary for this is decentralization of responsibility for programme development down to the level of state, district and classrooms. The implications of this for pretesting, science instruction, examinations, etc., are elaborated. The authors have reported the results of a study of "culturally different" pupils in Canada to show the efficacy of the proposed scheme of evaluation.

It is gratifying to note that some significant curricular improvements in science education have been made in India, though there have been few improvements in the area of evaluation and examination.

The system of evaluation, in India, generally reflects the existing system of education. At present, teaching and learning are

primarily done for the purpose of passing the examinations. The present curriculum in science in India is in fact dominated by an examination system. The science teacher places emphasis on memorization of certain scientific principles. Teachers are expected to follow closely the syllabus prescribed by the state and the science curricula are such as to enforce a descriptive and didactic process of teaching. The teacher fears that he will be branded "poor" if he does not finish the prescribed course within the term. Furthermore, his competence is judged by the percentage of students passing the departmental or university examination.[1]

Perhaps the greatest evil from which school, university, and college education in India suffers is that teaching is thus subordinated to examination rather than the examination serving to faciliate teaching.[2]

The above conviction is supported in the following observation by Bloom of the University of Chicago:

> Examinations do much to control the behaviour, thoughts and attitudes of students and teachers alike. But no living individual o group is in control over the examinations, only a body of traditions and practices which have accumulated over the years. The syllabus usually contains a detailed list of topics and it suggests that education is equated with the acquisition of some detailed information on each of the topics listed. The effect of such a syllabus and the pressure of time and numbers of students make information on each topic the major purpose of instruction for the teachers, the major objective emphasized by the examiner and the cramming of such information the major task undertaken by the student.
>
> A comparison of the question papers over several years reveals a highly stereotyped character in the questions set. Originality in setting questions is not valued. The necessary materials for setting a paper are the syllabus and the old question papers, the same tools as the student used in his preparation for the examination.[3]

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[1] R.M. Kalra, "The Chemistry Teacher in a Developing Country", *The Journal of Canadian Chemical Education* (October, 1969), pp. 3-6.

[2] *Report of the Education Commission,* 1964-66, (New Delhi: Government of India Publication, 1966), p. 162.

[3] B.S. Bloom (ed.) *Evaluation in Secondary Schools* (Delhi: DEPSE, Sec. Education, 1961), p. 123.

The leakage of examination papers and copying in the examinations are quite frequent. For instance, in September-October 1967, twelve different question papers of university examinations were leaked out in Kerala University. Examination on several subjects had to be cancelled.[4] This is academically debilitating.

From the financial standpoint as well as from the academic it seems highly undesirable to subject the pupils' work of a full year, or more, to a single, externally formulated examination as the sole basis for evaluating progress. Superintendents, invigilators, and supervisors are hired at each examination centre, adding to the cost of maintaining the examination system. The rupees spent on these external examinations might be better utilized in improving the existing facilities in educational institutions.[5]

A further contention regarding the weakness of the external examination system concerns what appears to be a serious educational consequence. The experience of one of the authors first in India and later teaching in high schools and a university in North America permits a reasonable, though subjective, comparison of students in India and North America. The student in India is no less intelligent than his counterpart in North America. This contention is re-enforced by the observation that many students who migrate to North America achieve just as well as they did in India, provided they are fluent in English, once they become adapted to the educational system. The need for some adaptation points to an interesting difference between Indian students and North American students.

The combined experience of the authors, covering the range from student in India to college professor in North America working with students who received all of their early education in India, suggests that the learning mode practised by the Indian student is essentially one of rote memorization, while the North American

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[4]S.N. Mukerji, *Education in India Today and Tomorrow* (Baroda: Acharya Book Depot, 1969), p. 482.

[5]R.M. Kalra, "Brain Drain of Qualified Young College and University Educators from Developing Countries." (Approved for publication. To appear in: *Improving College and University Teaching*, Corvallis, Oregon State University).

student is less concerned with memorization and more oriented toward learning the underlying concept and its subsequent application in other situations. The emphasis on memorization demanded by the external examination system in Indian education seems to make this difference inevitable.

This contention has been substantiated by various Fulbright professors working in India.

Cook (former Fulbright professor in India) states:

> Indan students, like students everywhere, have problems that require the help of professionally trained people Because India is in throes of social and economic changes and these changes clash with the restrictions of a rigid society and because its educational system suffers from inadequacies and restrictions in vital fields of study and in teaching methods, the problems of these students are doubly intensified.
>
> His education is generally based on rote learning, highly verbal in its emphasis, with little stress on independent study or thinking, and not often geared to the needs of a modern society He is taught in a highly formal atmosphere where the teacher is regarded as the voice of authority. His knowledge is tested once a year by anonymous external examiners, almost exclusively through essay questions that call for little more than the regurgitation of lecture notes covering the contents of an often obsolete syllabus. He cannot afford to buy many books, and his college or university library may not be adequate in his field of study. And finally, he may be pushed into the labour market with his degree only to find no jobs available for which his education qualifies him or to find that he is not qualified for the jobs that are available.*

Further, in a survey by Cormack author of *She Who Rides a Peacock: Indian Students and Social Change*, Indian students objected to the following aspects of the educational system in India:

(i) the external examinations,
(ii) insufficient choice in selecting courses.
(iii) not being allowed to express their ideas freely,
(iv) the aloofness of teachers.

In spite of such expressions by scholars regarding the evaluation and examination system in India, the problem continues no closer

*David R. Cook. "The Indian Student Analyzed", *Overseas—The Magazine of Educational Exchange*, (New York: The Institute of International Education), January 1964, Pp. 11-12.

to the solution. The educational system in India still remains rigid with very little progress evident. It seems likely that the critical problem of evaluation and examination exists only peripherally in the consciousness of the government and various education agencies. being secondary to problems of curriculum, facilities, finances, *et al.* The authors feel, however, that the problem of examination is central because it tends to perpetuate the traditional mode of learning based on memorization and regurgitation of conceptually isolated scientific principles by the students in the examination!

The result of this is a stereotyped system of professionalism which is now perpetuated for its own sake. It is an expedient system. Any innovative proposal for altering the system inevitably meets with a large amount of resistance or simply inconvenience, in the name of expediency.

In summary, the examination system represents a drawback in the educational system of India of a magnitude much larger than some of the problems to which far more attention is given and indeed revising the process of evaluation may remove obstructions to progress in these other areas.

A Closer Look at the Teacher's Role

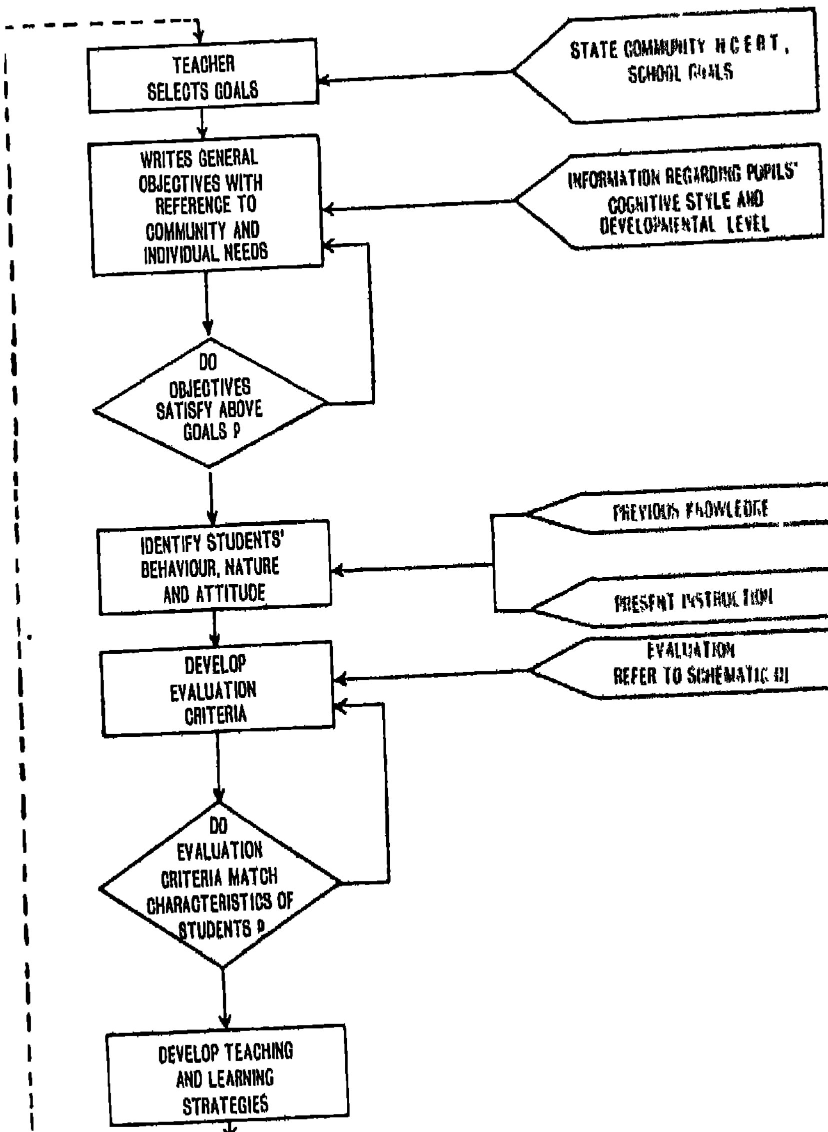
Some specific of evaluation of an important aspect of science education, experimentation, will serve as an example of how the examination system stifles learning. It is most unfortunate that laboratory experiments in the majority of high schools in India, tend to be run in a mechanical manner without affording much opportunity for any original thinking from the students. Most of the time is spent on getting the *correct* answer. This gives a false concept of the whole scientific endeavour. By emphasizing an official answer which must be arrived at, the rigid evaluation of laboratory work encourages memorization, rather than creativity and thinking. It stresses answers rather than understanding of the method of which answers are arrived at. Now the question arises immediately in one's mind: What should be the nature of an evaluation system in science education in India if it is to promote more than memorization?

In the opinion of the authors, a system of evaluation is needed that will help young students to develop skills and acquire knowledge which will produce a better way of life for them and which will make it possible to lead the students to the discovery skills so necessary if they are to use their knowledge. The primary aim of science education in India should be to serve the future, i.e., to provide the students with knowledge as a usable tool for the improvement of living. The struggle to make a laboratory manipulation lead to an answer already known and blessed with official status does not lead to the ability to use knowledge to solve problems. To achieve the higher goal, the evaluation system, the curriculum and the teaching methods need to be seriously re-examined.

The evaluation system should lay emphasis on understanding rather than memorization. The curriculum and methods of science teaching should be devised so that intellectual competence and educational self-direction will be developed.

In order to achieve the above aim, programme development should be a responsibility of the science teachers at *all* levels—state, district, and classrooms. Although science teachers in India want and need all the help and advice they can get from various education agencies, like National Council of Educational Research and Training and Department of Education, the ultimate responsibility should be *theirs*. This cannot happen if the system of external examination continues to dominate the teaching. The following schematic representation summarizes the role which the *teacher* should play in the development of the evaluation programme. Note that in the schematic diagram, the *operator* in the series of steps described is the *teacher*, with assistance coming from educational agencies, and community and other sources.

The process direction in Schematic I moves from the general goal structure, based upon inputs from all levels, towards specific, short-increment teaching strategies. The process takes into account all available information regarding the students, individually and collectively. The process can recycle at any point; i.e., information resulting from evaluation attempts can become an input into recasting the evaluative criteria. Most important of all, in this process the teacher is the only agent close enough to the active level



SCHEMATIC REPRESENTATION NO 1

to maintain the close tie between the development of goals and objectives, the development of an appropriate evaluative system, and the development of specific teaching strategies required if the process is to work optimally.

No intent to minimize the role of external agencies is involved; rather the intent is to make more effective the translation of all inputs, both external and internal, into realistic teaching strategies and evaluative devices. Evaluation methods should be determined by the goal structure and should reflect and at the same time influence the teaching process. In the absence of this relationship, evaluation becomes the goal, *de facto*, and teaching follows the path of least resistance.

The aims of science education in elementary and high schools should focus on the development in students of the ability to work with the materials of their environment and solve problems as close to reality as is practicable. Thus, general objectives should lay emphasis on performance rather than on the accumulation of facts. It should be the responsibility of the teacher, utilizing the assistance available from all sources, to determine the degree to which each student is developing his own skills in scientific investigation and acquiring appropriate scientific knowledge.[7]

To promote the performance goals, the process of selecting content areas and developing evaluative criteria and teaching strategies consonant with the goals should involve the identification within each area of those skills, both intellectual and manipulative, that are associated with successful performance. If the previous suggestion that it is the teacher's responsibility to determine the students level of development is accepted, it follows that for each block of work (topic, chapter, unit, etc.) the appropriate skills, behaviours and even attitudes should be identified to become part of the students evaluation for that block of work.

Schematic II illustrates in abbreviated form a record keeping device for the teacher operating as suggested in Schematic I. Fourteen items to be evaluated are listed, covering a variety of performance areas. This list could be extended to include many other

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[7]Department of Education, *Elementary Science* (Victoria, B.C.: Department of Education of British Columbia, p. 30).

items. For example, such things as facility in the use of apparatus, or specific behavioural change might be added. Likewise, the breakdown across the top might be altered to include major topics or individual chapters from the text instead of units. In any case, one or more such sheets would become the student's record for a course, covering many aspects of performance rather than simply the students' ability to respond when questioned with the appropriate section from the instructor's notes.

The way in which the information is used might vary with the purpose of the particular evaluation. That is, one purpose might be served by reporting academic information only, while for another purpose it might be of more importance to report specific skill areas such as "ability to express ideas clearly". Admittedly, this entails added work for the instructor as well as added responsibility, but the authors have nowhere contended that building a system of evaluation around criteria other than rote academic learning should be easy.

Examinations and the Threat of Failure

Millions of pupils appear every year in India at the matriculation or equivalent examinations. Of these, almost 40-50 per cent fail.[8] These failures inevitably result in frustrations, implying, to a certain extent, that education is a painful process. In the opinion of the authors, education should be more nearly a source of pleasure to the student than a source of pain, instilling in him a desire to learn, reinforced by guidance from a qualified, interested and humane teacher. This does not necessarily mean to make education easier, however. It means, rather, that the role of the threat of failure should be reduced and that of motivation increased. In the experience of the writers, the threat of failure has a negative effect on the pupil; the threat results in a dislike for the subject. On the other hand success is more likely to result when interest is aroused. The development of interest—motivating the students to do quality work—should be the responsibility of the teacher. Clearly teachers should increase their attempts to motivate pupils by

[8]Mukerji. *op. cit., p.* 479.

Student Name : ______________ Class ______________

	UNIT I (Ch. I, II, III)				UNIT II (Ch. IV, V)				UNIT III (Ch. VI, VII)				UNIT IV (Ch. VIII, IX)				General Comments
	E	G	S	U	E	G	S	U	E	G	S	U	E	G	S	U	
1. General Understanding of the concepts																	
2. Expresses ideas in terms of scientific language																	
3. Observation Power																	
4. Forming Hypothesis																	
5. Drawing inference																	
6. Interpreting data																	
7. Experimenting and Manipulative skills																	
8. Ability to express ideas clearly																	
9. Active participation in the class discussion																	
10. Original approach to the course content																	
11. Application of knowledge to the daily life																	
12. Home assignments																	
13. Written Exam.																	
14. Behaviour change																	

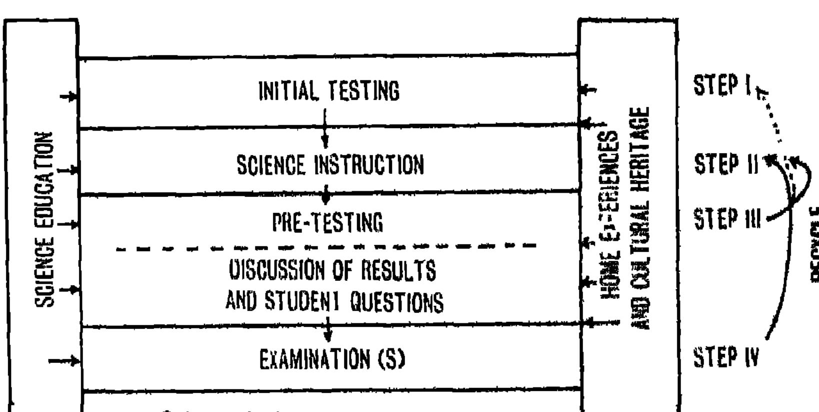
E—Excellent S—Satisfactory
G—Good U—Unsatisfactory

SCHEMATIC REPRESENTATION NO. II

making their teaching more interesting and meaningful. Teaching aimed solely at passing the external examination is not likely to be either interesting or meaningful.

It is not the purpose of this paper to discuss motivation devices or ways of making the curriculum more meaningful, important as those things are. Rather, the purpose here is to suggest some ways in which the examination system can be adapted so as to reduce the level of threat, and hopefully, to provide more opportunity for the development of a higher level of understanding than that reflected by rote memory. As a first step, it seems to be necessary to remove the all-or-nothing context in which the external examination operates.

Before relegating a student to a "third division" or "F" for poor performance, especially in the "one-try-sink-or-swim" nature of the external examination, the teacher should have exercised a planned series of evaluative steps aimed at integrating evaluation with teaching so that it not only provides feedback on attainment but also serves as an important teaching tool. Schematic III summarizes such a series of evaluative steps which the authors believe to be applicable in India.



Schematic Representation No. III

An Evaluation Sequence which Recognizes Different Degrees of Background and Science Proficiency

The evaluation model suggested in Schematic III on previous page is comprised of the following steps.

Step I: Initial testing. Initial tests are designed to reveal the previous level of achievement in a particular area of science; they are thus diagnostic in nature. If the science teacher is aware of the background of his students, he should be able to develop an individualized or semi-individualized programme of studies designed to correct background deficiencies and meet instructional goals according to the needs of the student, while maintaining a pace designed to allow the better students to complete a significant amount of work.

Step II: Science instruction. As discussed earlier regarding the threat of failure, the authors believe that the mode of science instruction can be adapted so as to reduce the level of threat, with the result that the students are given an increased sense of accomplishment and responsibility. While the purpose of this paper is not a discussion of instructional method, a brief mention seems appropriate here.

In order to accomplish the aim indicated above, the authors feel that the single, whole-class methodology must be modified to allow for varying degrees of individualization of the work. As an example of a useful mode of individualization, the contract method has been found to be helpful in a variety of situations. In introducing the contract method to students for a block of work, the teacher makes it clear that the student may work toward obtaining any division or grade he wishes. If he desires to have a "third division" he must accomplish a specified amount of work and pass an examination related to it (see Steps III and IV). However, if the student desires to have a "second division" or "first division", he must complete additional amount of work as specified in advance by the teacher and pass the examination for that level of work. The teacher consults with each student regarding the contract he has made as to its realistic probability of being completed. Having agreed on the contract, the student is assured that he will receive the desired grade if he completes the work.

The contract system is a flexible device that can be open-ended. For example, if a student feels that he is incapable of completing the contract for some honest reason, the contract can be negotiated

again. In this mode of learning, the student can feel free to question or to differ with the teacher without fear of its affecting his grade. Class discussions can be more open, encouraging an increased level of class participation and generating an atmosphere of freedom in the classroom.

Step III: *Pre-testing*. After a programme of instruction in some topic or block of work in science, for example the mole concept in senior chemistry, the instructor should give a pre-test. The "pre" in this usage connotes *preliminary*, an evaluation device not intended to produce grades for record but rather a combined review device and evaluation of the degree to which the material has been understood by the students so that any necessary re-teaching can take place. Further, the students should be asked at this point to develop and hand in questions for discussion and particularly ones which they feel might be used on quizzes. (The ability to ask a good question is a useful index of understanding). These questions and the students' participation in discussion of them and of the results of the pre-test should be considered a part of the evaluation for which a place is provided in Schematic III. This discussion and probing via student questions may constitute the needed re-teaching, or some more formal procedures may be prescribed by the teacher.

Step IV: *Examination* (*s*). The next step is the examination. The "examination" could be a single formal-type examination or could consist of the sum of quizzes on parts of the topic or block of work. The students should be given a quiz on each major topic or textbook chapter. In order to move on to the subsequent topic or chapter the student must pass the quiz on the current topic or chapter. Each teacher should decide what is a "passing grade". Students should be permitted to take a quiz or a parallel form of it more than once if necessary in the teacher's judgment to move on, but only after some further instruction. (Re-taking of quizzes should be minimized, however, by the use of the pre-test.) Some reasonable time limit should be set on how long a student spends on one topic, with the teacher exercising judgment as to the continued study.

After passing a quiz or examination, the student returns to step I or II, as needed, and the process repeats. This is the

"re-cycling" indicated on the schematic. In some cases the quiz or exam. can serve as the diagnostic initial testing for the next topic and the re-cycling goes to Step II instead of Step I. Another re-cycling arrow in the schematic indicates the return to Step II from Step III if the pre-test suggests more instruction is necessary.

The sequential evaluation procedure suggested above is compatible with the suggestions made in connection with Schematics I and II. It allows the students to proceed within reasonable limits at their own rate. This, in turn, is compatible with the Indian philosophy of time and the completion of tasks.

This method of integrating evaluation with teaching also takes into consideration the likelihood that some of the better students may complete any given examination in less than the prescribed time limit. To satisfy these more rapid learners, the teacher should provide differential assignments involving more difficult tasks and evaluations, probably leading to first or high second division credit.

The Suggestions in Use

One of the authors has secured very encouraging results from implementing the procedures suggested above (Schematics I, II, and III) while working with culturally different children in Canada. The student's increased progress and interest in the subject were quite evident in the example that follows.

There appears to be a striking resemblance between culturally different children in Canada (in this case American indigenous Indians) and rural students in India. Both groups of students are generally disinterested in science and this lack of interest is often a major factor in failure in the subject. That these students need individual recognition and attention is quite apparent. The authors hope that the following indication of results with culturally different students in Canada might help to establish the potential for success of the above evaluation procedures in India.

This informal study was undertaken with the following specific objectives: To compare students' attainment when using a traditional evaluation system with that when using the authors' suggested system. The study was carried out at Mission Secondary School, Mission, B.C., Canada, during the academic years 1969-71.

The population of students included classes of general science and senior chemistry totalling 252, grouped as shown in the following tables. The formal instruction imparted in each subject was the same for each year, and the evaluative criteria utilized for testing were the same both across classes and from year to year. The students were indigenous American Indians, truly a culturally different population when compared to the general population of Canadian students.

The achievement scores noted in the following tables comprise written quizzes and other factors as indicated in Schematic II. No cumulative effect of the use of the suggested system is involved since no students in the general science groups had reached the chemistry classes during the course of the study.

TABLE I
(1970-71)

Results with the Traditional System of Evaluation

Characteristics	*Categories*	*No. of Students*	*Achievement* *E'*	*G'*	*S'*	*U'*
General Science	A_1-up to 14 years	21	1	7	7	6
Chemistry	A_2-up to 16 years	24	1	5	10	8

TABLE II
(1970-71)

Results with the Author's Evaluation System

Characteristics	*Categories*	*No. of Students*	*Achievement* *E'*	*G'*	*S'*	*U'*
General Science	A_1-up to 14 years	21	9	4	6	2
Chemistry	A_2-up to 16 years	26	2	11	10	3

TABLE III
(1969-70)

Results with the Traditional System of Evaluation

Characteristics	*Categories*	*No. of Students*	*Achievement* *E'*	*G'*	*S'*	*U'*
General Science	A_1-up to 14 years	36	3	10	15	8
Chemistry	A_2-up to 16 years	40	4	3	25	8

TABLE IV

(1969-70)

Results with the Author's Evaluation System

Characteristics	*Categories*	*No. of Students*	*Achievement* E'	G'	S'	U'
General Science	A_1 up to 14 years	35	8	15	11	1
Chemistry	A_2-up to 16 years	45	8	14	20	2

NOTE: E=Excellent G=Good S=Satisfactory U=Unsatisfactory

The results on the previous page suggest that the students attained more when the author's evaluation system was used than with the traditional system. That they learned more is suggested by an increase in average test grades when viewed as a single criterion. There was a general increase in each class. Admittedly the study is not experimentally "clean" and one certainly cannot infer any causative relationship. Still, subjective observation suggests that some of the components built into the proposed evaluation scheme of Schematic II are tied to a positive shift in interest in the course. The writers believe that the proposed scheme builds on a feeling of reduced failure potential by the students, resulting in a reduced antipathy toward science. In the absence of a thoroughly controlled experiment, this is a tempting explanation of increased achievement.

These results are, of course, highly subjective in interpretation but the writers' strong feeling is that two very important factors are operating. First, the system makes it clear to the students that their grades are not entirely the reslult of their rote-learning performance as reflected in test grades. Second, the cycle of teaching and testing activities described reduces the feeling of finality—and hopelessness—attached to any given evaluation.

The success of these evaluation procedures in stimulating culturally different children to improved performance has significance for the system of education in India where an important fraction of the secondary school student population is indeed different by virtue of a vastly different environment (rural India) and life style from that of the other major population group.

Some Suggestions toward Improving the Evaluation System in India

The following suggestions are felt to be generally desirable, rather than absolutely necessary to the teaching environment. It should be kept in mind that these suggestions are not meant to be prescriptive nor are they necessarily applicable in all situations.

1. Evaluation procedures should be consistent with the philosophy of continuous growth. The problem of external examinations is not simply the presence of examinations themselves, but the degree to which they dominate the entire system of evaluation. To measure progress, we must evaluate each student against himself by taking into consideration his present level and his past level of achievement as well as that of others. An effort should be made to devise an individualized programme for each student in secondary schools. The authors have suggested a method of evaluation which incorporates the concept of individualization (refer to Schematic Representation No. III). The evaluation system should be organized to permit some greater degree of flexibility. A rigid external examination with its emphasis on memorization is not in accord with our present knowledge of individual differences and the importance of attitude to be developed in these students.

In the opinion of these writers the importance of the external examination system applied to all students should be *gradually* reduced. (The sudden abolition of the present examination system would probably bring on educational chaos in the country.)

2. The authors have previously suggested a system of continuous internal assessment by the teacher instead of the existing external examination system. The system of internal assessment is based on two assumptions: (a) the teachers' integrity; and (b) the students' and teachers' willingness to accept the concept of internal assessment.

The writers do not challenge the integrity of the teacher but point out an urgent need for a drastic change in the teachers' role from that of a dictator to that of a resource person or a guide. At present, in India, student-teacher relationship has been a one-way traffic. Thus, the teacher and the student are never actually involved as partners in the learning process.

This would, the authors feel, result in an *upgrading* of the role of the teacher in the selection of goals and in developing appropriate teaching strategies and evaluation devices in meeting those goals.

3. The evaluation system should foster the development of a positive self-concept for each student. In India, it is quite common that poor students' failure, especially in rural high schools in science, is due to unhealthy perceptions of the self and the world. Evaluation procedures must recognize the right of the child to be appreciated for what he is and for what he has the potential to become. The writers have already suggested a method of evaluation that they felt will impart a reasonable feeling of possible success to these students through a reduced level of emphasis on one-try evaluation of rote-learned material.

4. Evaluation stress should be put on helping pupils learn to think, to develop fresh meanings for themselves, to examine possibilities and to create new combinations from original or available data. That is to say, evaluation should be, itself, an act of teaching.

5. Students should be given opportunities to develop the concept of self-evaluation. The pupils should be encouraged and assisted in setting achievable goals for themselves. What is the use of teachers' establishing lofty goals for their students if they are incapable of achieving them ? The resulting frustration adds to the problem of low self-concept. The students should be encouraged to participate in class and group discussions. The participation in group discussions would help each student to know his responsibility in a group situation and become aware of his own strengths and weaknesses.

6. Evaluation should not be confined to school buildings. Field trips should be an integral part of the school programme. The students should be encouraged to utilize community facilities. The following example illustrates the idea:

> Rather than giving the written essay-type examination on the topic "Applications of Science in our Lives", totally within the classroom, the students should be asked to submit a report on the above topic by making use of community resources (Panchayat Officer, Block Development Officer, parents, and other learned community members).

7. The broad aim of science education in India should be to develop in students the ability to work with the materials of their environment and to solve problems presented to them. Thus the evaluation system should not only focus on the performance of a student in a written examination but also on the development of positive scientific attitudes and scientific behaviour (refer to Schematic Representation No. II).

8. Another most important aspect of evaluation is questioning technique. Questioning is indeed a very challenging technique. In order to be expert in this technique, one has to know not only the subject-matter, but also a good deal of psychology. The writers suggest a concentrated effort within the existing system to upgrade the average teacher's skill in questioning as essential to the earlier suggested increase in the teacher's role in the evaluation system.

9. In the opinion of these writers, government and various educational agencies like, National Council of Educational Research and Training, should launch a programme or pilot project to improve existing evaluation and examination system in India.

Conclusion

If the problems of examination and evaluation are placed in the hands of qualified, experienced, and creative personnel, with reduced constraint by the external examination system the resulting imaginative programme would provide a forward-looking approach to the examination and evaluation system in India. It is the writers' hope that the suggestions offered here will serve to encourage all concerned to think, organize, and strive further together toward helping students in India to think, discover and contribute to scientific knowledge and a better India.

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System of Teacher Training in the German Democratic Republic

Wolfgang Rocksch

In reconstructing the educational system of the German Democratic Republic after World War II, it was necessary to prepare teachers who could bring up the new generation for a socialist society. Anti-democratic ideologies of Nazism had to be eliminated. Also, while retaining the excellence of German intellectual and university tradition, it was necessary to democratize higher education itself and to integrate teacher education with the system of higher education. Common general education was extended from 8 to 10 years and the general and specialist teachers of the new polytechnical schools were provided both a thorough foundation in general theory and their special subjects and an effective programme of practical work linked with an enriching theory. Independent research by intending teachers is particularly emphasized in the later years of the teacher training programme. Special stress on educational science linked with the practice of the socialist school marks the programme.

In the two and a half decades of our construction effort the leadership of the party of the working class and the Government

of the German Democratic Republic (GDR) devoted particular attention to all questions concerning the training of teachers; the attitude, the knowledge and ability of the teacher are decisive factors influencing the education of the young generation and thus influencing social developments as a whole.

The training of a new generation of teachers was one of the most important steps in the construction of an anti-fascist, democratic order after 1945. Approximately 72 per cent of the teachers in office up to that time had been members and active adherents of the Nazi party, to whom the task of the democratic re-education of youth could not be entrusted. They were replaced by tens of thousands of young teachers, mainly of working class origin. Although only scantily prepared for their work from the point of view of professional knowledge and methodology in emergency training courses of two to nine months, these "new teachers" became decisive pillars of support in the effort to implement the antifascists democratic school reform in their diligence and devotion and above all their progressive political attitude. During the fifties they developed into qualified specialists, mainly by way of correspondence courses, and have for years formed the proven core of our headmasters, leading educational workers and teacher-training staff.

Simultaneously with the training of new teachers, which constituted a necessary transitory measure, long-term measures were introduced to provide the new school with the required number of fully qualified and suitable teachers. These arrangements during the years 1945-1949, became integrated in the broad framework of the anti-fascist, democratic transformation of our education system. The training of teachers for the junior, the middle and the senior classes of general education schools was based on the principles of integration and scientific substantiation. The faculties of educational science created at the universities during the first phase of our development took a decisive part in overcoming the contrasts between the training of elementary and secondary school teachers. Those faculties trained both, teachers for the junior classes and specialists for the secondary schools.

Today the GDR has a fully developed, efficient system of teacher-training that constitutes a sound foundation for the accomplishment of all, including the new comprehensive tasks in the phase

of the completion of socialist construction. All the tasks to be accomplished during the period of completing socialist construction are immediately linked with questions of education. The educational system provides the intellectual basis for their solution and thus performs a pace-making function within the entire social system. The advanced socialist system demands an all-sidedly educated, highly qualified socialist citizen.

The prospects of the development of education are laid down within the Law on the Integrated Socialist Education System[1] which had been passed in 1965, after one year of broad public discussion, by the Peoples' Chamber of the GDR. That law envisages an education system, the components and phases of which are so adapted to each other, from pre-school education up to university level and adult education, that they form a complete system in their content and structure. The core of that system is the ten-year general polytechnical secondary school, which is attended by all children and mediates the foundations for all further education. The main way to university is the attendance of the two-year extended higher secondary school after the ten-class school (see Appendix 1 and 2 for time-tables of polytechnical and extended secondary school).

The tasks envisaged by the Education Act of 1965 are based on the social structure. They are deduced from the question as to the requirements that will be facing the children (admitted to school today) in the year 2000 A.D. The new curriculum for the ten-class polytechnical secondary school was worked out from this point of view.

On the basis of the Education Act a number of important documents were issued during the following years after a thorough discussion, in which the specific functions and tasks of the education system in its different sections and phases and their coordination within the whole system were discussed. In this connection great importance was attributed to the problems associated with the train-

[1]*Law on the Integrated Socialist Education System.* (Education Act of 1965), In our education system, an important step on the way towards an educated nation. *On the work of the People's Chamber and its Committees.* Issued by: State Council Chancellery. Vol. 5. (4th election period). Documents of the 12th session of the GDR People's Chamber and Education Act of 1965.

ing of teachers, since the concept of the pace-making function of education in the advanced system of socialism applies in particular to this domain.

In her report at the Seventh Congress of Education in May 1970, Margot Honecker, Minister of Public Education of the GDR, pointed out that the quality of the training of teachers was decisive even today for the extent to which schools would comply with the growing requirements of education and instruction during the coming decades. She explained the implications of providing the necessary foundations in the training of teachers stating that:

> teacher students should above all be aware of their specific responsibilities as teachers towards socialist society and the future of the children entrusted to them. The maturity of the teacher as a citizen and in his character is a decisive condition of the success of his educational activity. Training courses must provide the future teachers with a profound knowledge of their own subject of science and with a sound knowledge of educational theory. It must be assured that training is not merely confined to the mediation of book-learning; all aspects of the training must be associated with advanced educational practice, and students must be given opportunities to participate in the assertion of new, progressive ideas in school education, even during the time of their training. The students should play an active and creative role in the process of their training, inspiring them to strive to continue the improvement of their knowledge and abilities also after the conclusion of their training.[8]

The basis document for the further development of teacher training is the "Conception of the Perspective Development of the Training of Specialist Teachers for the General Polytechnical High School in the GDR for the period from 1968-1980",[9] jointly issued by the Ministry of Public Education and the Ministry of Higher and Technical Education. In its content it has been adapted to form the basis of the State Council Decision, "The Continuation of the Third University Reform and the Development of

[8]See M. Honecker: We teach and learn in the spirit of Lenin. In *Information of the German Teachers' Journal.* Deutsche Iohrorsiotung, No. 20/21/1970, p. 37.

[9]*Conception of the Perspective Development of the Training of Specialist Teachers for the General Polytechnical High School in the GDR for the period from 1968-1980, Berlin,* Jan. 15th, 1969. Ministry of Public Education, Ministry of Higher and Technical Education.

Higher Education up to 1975"[4] of April 1969.

New programmes have been elaborated for the training of teachers in compliance with the general lines of development courtlined in the law on the integrated socialist education system, in the State Council decision on the continuation of the Third Reform of Higher Education and in the conception of the perspective development of the training of specialising teachers. That task was entrusted to the special commissions appointed by the Ministry of Public Education or the Ministry of Higher and Technical Education, which are composed of distinguished representatives of educational training institutions. Following the discussion on the draft programmes at the educational training institutions and the endorsement of the revised drafts by the Ministry, the practical introduction of the new training programmes was begun in the school year 1969-70. At the same time measures for the evolution of the experience collected in the course of practical work were introduced, which are to facilitate the further clarification of the programmes during the coming years.

Structure of Teacher-Training

With the transition from eight-year to ten-year general education, to be completed in the course of the nineteen-seventies (in the school year 1969-70, 84 per cent of the corresponding age-group attended the 9th and 10th classes of general schools), with the development of whole-day education, the introduction and extension of a system of school clubs, etc., there was, a considerable increase in the need of teachers. That is why there is an intense and long-term campaign at the polytechnical and extended secondary schools to win pupils for the teaching profession. In 1969-70, 2,615,200 pupils of polytechnical secondary schools and extended secondary schools were taught by 141,355 teachers (that means 18 pupils per teacher). Up to 1980, 90,000 new teachers are to be trained.

[4]State Council of the German Democratic Republic. *The Continuation of Third Reform of Higher Education and the Development of Higher Education up to 1975.* Documents of the 16th session of the GDR State Council of April 3rd 1969. Series issued by the State Council, Vol. 8, 3rd election period, Staatsverlag, Berlin 1967, pp. 62-69.

Teachers for the junior classes (1-4 prior to the Education Act and 1-3 since 1965) are being trained at 30 teacher-training institutes with the status of technical colleges. The condition for admission to the training as teacher of elementary classes, which now takes 4 years and previously took 3 years, is the successful completion of the study in the 10-class polytechnical high school.

According to the "Conception on the New System of Training Teachers for the Junior Classes" of December 1964, the students are no longer being trained in all subjects taught in the junior classes. They acquire the qualification to teach German and mathematics and a third optional subject. (Works-experience, physical training, music or art education, or instructions in the school garden). Apart from the three subjects of instruction, the training comprises a course in elementary social science, educational science and psychology. The students extend their knowledge of Russian, they have instructions in sport and attend optional courses in natural science, technology, economics and culture, which serve the consolidation of their general knowledge.

From the first year the training is closely linked with school and educational practice. Each institute of education is associated with a general polytechnical high school. During their training the students have several periods of practical training, including work at a nursery and at summer holiday camps, etc. The half year of school practice (7th semester) when the students work independently as teachers and in external educational activities, represents the climax of the practical training.

The present transformation in the training of junior class teachers are above all aimed at the further increase of the theoretical level of the training and to give students improved foundations for independent scientific work. At the same time measures have been introduced for the further scientific qualification of teaching staff, so that essential prerequisites are provided for the transition to forms of higher education at the teacher-training institutes.[5]

Teachers of elementary classes have an opportunity to acquire the qualifications of specialists for teaching in the higher classes by means of participation in correspondence courses.

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[5]*Educational Training in the GDR,* Volk and Wissen Ver Volkseigoner Verlag, Berlin, 1967, pp. 62-69.

The training of specialists for teaching in the middle and senior classes takes the shape of a four-year course at universities, and at teacher-training colleges. It is an academic training and ends with the degree of a certificated teacher, specialising in two subjects, (the main and a secondary subject) like B.Sc., B.Com., B.Ed., Tech. Applicants for admission must have passed the *Abitur* examination after completion of the 12-year general education.

Full-time studies at all universities and similar institutions in the GDR are provided tuition free of charge. In addition approximately 90 per cent of all students in the GDR are receiving state scholarships. Students pay 10 marks a month for living at a students' hostel. About half the students in educational training are of working class or peasant origin.

All institutions training specialists for the higher classes work according to a programme enforced by the Ministry of Education and the Ministry of Higher and Technical Education. The colleges of education in Potsdam, Dresden, Erfurt/Muhlhuasen, Gustrow, Halle, Kothen, Leipzig, Magdeburg and Zwickau exclusively train teachers. In distinction to the universities and technical colleges, they are directly controlled by the Ministry of Education.

The training of graduate teachers is composed of the following subjects:

—foundations of social science and philosophy,

—main subject and secondary subject of instruction,

—educational science, psychology and methodology,

—introduction to logic, scientific theory and/or to data processing,

—extension of general education (obligatory further qualification in Russian, optional instruction in a second foreign language, cultural and art education and instruction),

—sports.

The training is graded into two phases. During the studies in the first- and second- year complex courses in educational science, psychology, the two subjects of specialisation and the foundations of Marxism-Leninism stand in the foreground. The studies during the third and fourth years is marked by a greater specialisation

within the scope of the optional and obligatory lectures and a more advanced degree of independent research work and application of acquired knowledged in practice.*

The Time-Table (see Appendix 3) conveys an idea of the structure of the course and the relations between the different training components. The study of the foundations comprehends the scientific philosophy of the working class as the foundation for the solution of the development problems of our society and to make them the guiding principle of their actions in daily life. The students are given special courses in philosophy, political economy and scientific socialism. That training at the same time confronts the students with the comprehensive practice of socialist construction and enables them to participate consciously in the solution of social problems on the basis of their own scientific investigations.

The training in the two subjects selected by the students as their future subjects of teaching has a very high standard. Yet the training of teachers is adapted to the specific requirements and tasks of that profession.

After the sixth semester, the students complete a four-week course of practical training in the field of their main subject.

At all educational training institutions there are established "standard combinations" of subjects (chemistry and biology, mathematics and physics, German and history, Russian and English, etc.), which allow coordinated procedures in the training in the main and secondary subjects.

The introduction to data processing, to logic and to scientific theory represent new subjects, included in the course of the Third Reform of Higher Education at all institutions of higher education.

The educational science training comprises:

—the integrative lectures in the first and fourth years (elementary and concluding courses in educational science and psychology),

—lectures (and practical exercises at school) in the methods of teaching the two special subjects,

*Compare Instructions on the Development of the Phase of Specialised Studies within the Scope of the Training of Specialist Teachers for the General Polytechnical High School. In: *Regulations and Informations* by the Ministry of Public Education and the State Secretariat for Vocational Training, 1970, No. 4. Berlin, July 28th 1970.

—lectures in the special branches of educational science and psychology,

—practical courses in the first, second and fourth years.

Particularly able students may start a three-year course of post-graduate researches after the acquisition of their degree, which is concluded with the award of the title of a doctor of educational science (Dr. Paed.). After that they work as teachers mainly at experimental schools. They form a reserve pool of teachers for teacher-training establishments. Specialist teachers for the extended high schools leading up to university standard used formerly to be trained in a five-year university course. The general rise in the scientific standard of training achieved at all institutions in recent years allowed the elimination of the differences in the training of teachers for the middle and the senior classes.

Teachers for vocational training schools are trained at university level in the same way as general secondary school teachers. They are trained at the technical colleges, where they are qualified in their special subjects and obtain a thorough training in educational science. Teachers of practical vocational training are qualified at technical colleges. The unified standard of training, in particular in the sphere of educational science, is ensured by the State Planning Commission in cooperation with the Ministry of Public Education.

At all levels of teacher-training there are opportunities to study not only in full-time courses, but also in extra-mural courses. This was used in the past above all by teachers of the junior classes wishing to acquire the qualifications for teaching also in the higher classes. The numerous forms of external qualifications also include an additional course for graduates with qualifications in specific subjects of school instruction, but without educational training.

The Education Act of 1965 requires that the training and further qualification of teachers should be regarded as one process. Obtaining further qualification after the conclusion of the training is the right and the obligation of every teacher. In the GDR a system of courses for the professional and further qualification is in operation, in which all teachers are included.

decisive influence on the way in which the young generation is enabled to ensure the results of socialist construction and to utilise the possibilities for exercising political power within the scope of socialist democracy.

Teachers need a thorough knowledge of Marxism-Leninism for the fulfilment of their educational mission, as the "foundation of the theoretical and practical solution of the development problems of our socialist society."[9]

The mediation of Marxism-Leninism is not exclusively the task of the chairs of philosophy or political economy or sociology, but a matter of concern to all disciplines of training. The chairs in the technical, educational, scientific and general education disciplines are endeavouring to coordinate their lectures with the courses in philosophy, political economy and in the subject scientific socialism. They build up on the basic knowledge mediated there, apply that knowledge to the respective special subjects, and make the students aware of the Marxist-Leninist basic positions of their spheres of learning. The appropriation of Marxism-Leninism by the students not only takes place by way of the study of literature, but also by their direct participation in the political struggle of the working classes and in socialist construction. The development of the reciprocal relationship between theory and practice, which will be elucidated in the following paragraphs, was one of the main aspects in the elaboration of the new programmes of studies. The socialist youth association, the Free German Youth, took a number of initiatives with a view to ensuring a close connection between the student teachers and the working class, also beyond the scope of training features, and also with the comprehensive practice of socialist life.

The training must be developed as a scientifically productive course.

The State Council decision on the continuation of the Third Reform of Higher Education provides that the essential idea of that course consisted in combining socialist education with modern scientific training. This implied above all that the student acquires the latest knowledge and methods of independent scientific work,

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[9]*Ibid.*, p. 126.

in appliance of modern forms of studies and methods and linking the creative application of scientific knowledge in practice with the struggle for the construction of the advanced socialist system." The students are to be prepared for their tasks as teachers in socialist school practice by way of actively participating in the further development of socialist society, in particular in the solution of the most urgent problems in the sphere of education, even while still in training, on the foundation of reliable scientific knowledge.

The need for the development of the entire process of training as a scientific and productive course arises from the growing significance of the subjective factor, the creative activity of man for the further development of socialist society. The fact that science is increasingly becoming a direct productive force requires of every citizen of a socialist state the ability of independently acquiring scientific knowledge and to make a contribution towards the accumulation of scientific knowledge. This applies in particular to teachers, who are called to direct those process of personality development.

The question of the unity of learning and research therefore occupied a place of outstanding importance in the elaboration of the new programme of studies. The following practical aspects were above all established for implementing the principle of teaching with a research orientation:

—during the first two years the training is concentrated on integrated courses mediating a sound fundamental knowledge in the two special subjects and in educational science on the basis of the latest standard of scientific knowledge. Within this scope the students are also introduced to the main methods of scientific work. Even in this course modern teaching aids are used to a greater extent which will encourage an active acquisition of knowledge by the students.

—The immediate introduction of students in the first and second year to research work above all takes place by way of the scientific emulation among the students. The different faculties set themes for this, which are related

[9]*Ibid.*, p. 128.

to their main research problems and the subject-matter of lectures. Through this emulation the students mostly come into closer touch with the scientific discipline in which they are trained as from the third year and on which they will then write a thesis for their degree.

—In the phase of studies in the third and fourth year the students are directly included in the research work of the faculties. They can decide whether they wish to acquire an extended training in the area of a selection of obligatory lectures on the foundations of sociology and philosophy, in their main subject, in educational science, educational psychology or methodology. They write their theories in the selected subject, in the process of which they become firmly integrated in the research teams of the faculties. The team-work developed is characteristic of the new relationship of teachers and students at our teacher-training institutions.

—The transformation of educational training into a productive scientific course demands a new quality of the relations between theory and practice, both being considered in their dialectical unity. We regard the rise of the theoretical standard of the training as the main link in the chain in the better preparation of the students for their practical work at school. In the process of acquisition of theoretical knowledge the students should acquire the methods of independent scientific work and the ability to apply it in practice.[10]

The central practical domain of teacher-training is certainly the practical work at the socialist school. All work of education and instruction at teacher-training institution must be directed towards enabling the students to accomplish the concrete tasks as socialist teachers and educators. In so far the establishment of close relations of school practice represents a basic aspect of all training disciplines. The new programmes of studies ensures that students are directly in touch with schools from their first year of training,

[10]M. Honecker: We teach and learn in the spirit of Lenin. In: *Information of the German Teachers' Journal,* Deutsche Lehrereitung, 1970, No. 20|21, p. 38.

themselves doing educational work. They direct their work towards the most advanced practices and pace-making achievements.

School practice represents the central, but not the only sphere of practical training to be considered in teacher-training. The complex nature of the work of teachers demands the comprehensive consideration of the concept of practice in teacher-training. Teachers must be acquainted with the practice of many spheres of social life (production, economy, politics, culture, etc.). Apart from school practice, the social and political activities and self-education of the students represent important domains of practical activity, particularly within the youth association, the potentials of which must be effectively utilised.

In the elaboration of new training programmes the foundations were laid for the development of a complete system of relations between theory and practice in the training of specialist teachers. This work has not yet been concluded. The following section will give information on the present position and show how the principles of development of the content of training are reflected in the sphere of educational science instruction.

Training in the Field of Educational Science

The main task in the field of educational science at present consists in developing the training in pedagogics, psychology and methods of teaching into a complete integrated system which makes growing demands on the students, and in this, the connection of theory and practical work at school is emphasised.

The development of the training in educational science at our training institutions was marked during the past two decades by an increasing differentiation. The growing development of partial aspects of educational science as separate subjects, the trend towards the increasing separation of general pedagogics and methods of teaching in the special subjects, educational science and methodology from pedagogics and psychology endangered the integrated nature of the training in educational science and obstructed the comprehension by the students of the complexity of the educational process.

The new teaching programmes also take the differentiation in

the field of educational science into account, but they are far more than their precursors, directed towards the trends of scientific development to integration. Particular attention was devoted in the elaboration of the new programmes to the complex structure of lectures and practical training.

One of the most important measures undertaken in the field of educational science training under the Third Reform of Higher Education was the introduction of the basic course in pedagogics and psychology during the first year. This was the accomplishment of a team-work by pedagogues, psychologists and experts in teaching methods in the special subjects.

This basic course envisages mediating to the students the fundamentals of socialist educational policy, educational science and psychology from a complex point of view as a basis of all further training in these subjects. In the lectures and seminars the following subject-matter is treated:

1. The growing importance of educational science and psychology. The nature of the process of education.
2. The dialectics of social development and education.
3. The all-sided development of the socialist personality.
4. The nature of the psychic element and the psychic processes and qualities of a personality.
5. The curriculum and tasks for the further development of the civic education of GDR school youth.
6. General principles of the creative development of educational processes.
7. The administration of the socialist education system.
8. Basic problems and methods of educational research.

Another new element introduced with the basic course in educational science and psychology is the practical work of students in the first and second year in the field of external education activities. At the beginning of their training, the students take up practical work of education in the children's and youth organisations, as a rule, at a school and under the direction of an experienced teacher. They work, for example, as heads of "Young Pioneers" groups or circles, up to the end of their second year of training. This not only gives them scope for the development of their own personality, but also an opportunity to make an active contribution to educational

work outside the lessons. This educational activity, which takes place at a school or factory, is a project of the youth organisation, a social mission to the students belonging to the "Free German Youth". It is also closely linked with the basic course in educational science and psychology. The teaching staff of the basic course in pedagogics and psychology lay certain theoretical foundations in their lectures and seminars. They advise the students and utilise the potentials of the educational activities of the students for an even closer association of their lecturing work with the problems of educational practice.

The practical educational work prepares the students for their practical training at the end of the first year in the summer holiday activities, where they work as leaders of groups in children's holiday camps. This activity and the special one-week camp to prepare the students for their work in the holiday camps are the responsibility of the educational science and psychology sections.

The experiences of teacher-training institutions of the year 1969-70 indicate that the introduction of the basic course in pedagogics and psychology and the educational work of the students have provided a good starting point for an upward leap in the quality of training in educational science.

The following advances were emphasised in particular as compared to provious training practice:

—The students trained according to the new programmes direct their work far more towards the requirements of the socialist school and stand out for a much more substantiated knowledge of educational science and psychology.

—The combination of a basic course in pedagogics and psychology and practical work promoted the development of a close relationship between the teaching staff of the educational science and psychology sections and the students.

—The complex nature of the basic course obliged the teaching staff for educational science to go beyond the scope of their own special subjects and to seek a dialogue with representatives of other disciplines. In this way many

pedagogies, psychology and methods of teaching in the special subjects. This final course, the concept for which is still being worked out, is to serve the evaluation of experiences collected during the main period of practical work at school, introducing the students to the latest results of researches in educational science and psychology and acquainting them with the basic issues of educational policy from the aspect of perspective development and international comparison—which are of particular significance in view of their entry to school service.

Margot Honecker, GDR, Minister of Public Education, outlined the perspectives of development of our educational system and defined the tasks of teacher-training institutes and teacher-training colleges as consisting of the speedy catching up with arrears in regard to the objective demands, particularly in educational science training.

> Our educational training institutions must train young specialists, fully aware of the greatness and importance of their profession. This requires the equipment of our students at such institutions with high political, moral and character qualities, their education to a strong sense of responsibility determined by the mission to educate our children into highly educated socialists. The training must demand a striving for educational perfection and rouse the desire of students to dedicate their entire personality to the great ethical concern of the teaching profession... The first visible successes in the practical application of these indications justify the expectation that the training of teachers in the GDR will be up to the increased demands of the period of the completion of socialist construction.

Practical scientific work is aimed at consolidating the knowledge of certain mathematical, natural, scientific, technical, technological and economic foundations, and laws of production. It is intended to consolidate and widen the knowledge and ability of public in the application of methods and techniques of intellectual work in the solution of practical scientific problems. Integrated skeleton programmes exist for fields such as electricity, electronics, chemotechnology, agrotechnology, economics, etc. These skeleton programmes are being implemented in cooperation with factories and scientific institutions.

In addition to the theoretical lectures the following practical courses are conducted:

—summer holiday practice (4 weeks after the second semester).
—educational and psychological practice (3 weeks after the third semester).
—main school practice (15 weeks from the beginning of January up to the middle of April in the 4th year).

(b) After the 6th semester (June-July) a week practice takes place in the special subjects.

Appendix 1 : *Time-table for the 1970-71 School Year*

Subject—Class	1 1st half	1 2nd half	2	3	4	5	6	7	8	9	10
German	11	10	12	13[1]	14[1]	7	6	5	5	5	4
Russian	—	—	—	—	—	6	5	3	3	3	3
Mathematics	5	5	6	6	6	6	6	7	5	5	5
Physics	—	—	—	—	—	—	3	2	2	3	4
Astronomy	—	—	—	—	—	—	—	—	—	—	1
Chemistry	—	—	—	—	—	—	—	2	4	3	4
Biology	—	—	—	—	—	3[1]	2[1]	1	2	2	2
Geography	—	—	—	—	—	2	2	2	2	2	1
Crafts	1	1	1	1	2	2	2	—	—	—	—
Gardening	—	1	1	(30)[2]	(30)[2]	(30)[2]	(12)[2]	—	—	—	—
Polytechnical instruction incl.	—	—	—	—	—	—	—	4	4	5	5
Introduction into Socialist Production	—	—	—	—	—	—	—	(1)	(1)	(2)	(2)
Production Work Technical	—	—	—	—	—	—	—	(2)	(2)	(3)	(3)
Draftsmanship	—	—	—	—	—	—	—	(1)	(1)	(—)	(—)
History	—	—	—	—	—	1	2	2	2	2	2
Civics	—	—	—	—	—	—	—	1	1	1	2
Drawing	1	1	1	1	1	1	1	1	1	1	—
Music	1	1	1	1	1	1	1	1	1	1	1
Sport	2	2	2	3	3	3	3	2	2	2	2
Needlework	—	—	—	1	1	—	—	—	—	—	—
Hours per keep	**21**	**21**	**24**	**26**	**28**	**32**	**33**	**33**	**34**	**35**	**36**
Second Foreign Language, optional	—	—	—	—	—	—	—	3	3	3	2
Needlework optional	—	—	—	—	—	1	1	—	—	—	—
Total	**21**	**21**	**24**	**26**	**28**	**33**	**34**	**36**	**37**	**38**	**38**

1 = including gardening (annually) : in classes, 3, 4 and 5 — 30 hours in each; in class 6 = 12 hours (1st half year).
2 = hours per year.

Appendix 2 : *Time-table for the Extended Secondary School* (1970-71).

Subjects	*Class* 11	12
German	3	3
Russian	3	3
2nd foreign language	2	5
Mathematics	5	5
Physics	3	3
Astronomy	—	1
Chemistry	2	3
Biology	2	3
Geography	2	—
History	3	—
Civics	1	2
Sport	2	2
	28	30
Elective obligatory lessons :		
Practical scientific work	4	4
Art Education or Music	1	1
Optional lessons up to	33	35
	3	1
Total up to	36	36

Appendix 8 : *Time-table for the Four Year Training of Specialist Teachers for the general education school (Basic Variant)*

Discipline	*Total hours (weekly per semester)*	*Semester* 1	2	3	4	5	6	7	8
Basic course in social science, economy and philosophy	20	5	4	3	3	1	2	2	
Educational Science Basic course	4	2	2						
Tedagogics	5			2	2			1	
Psychology	5			2	2			1	
Methods of teaching in the two subjects	15					6	4	4	1
Final course	3								3
Introduction to data processing, Logic and/or Scientific theory	5		1	2	2				
Foreign Languages	4	2	2						
School Hygiene	1								
Elocution	1	1							
Students' sport	14	2	2	2	2	2	2	2	
Seective obligatory Training	8						4	5	
Main subject	67	10	9	9	9	10	10	15	2
Second subject	45	10	9	9	9	6	2		

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A Conspectus of Studies in Programmed Learning

Gunvant B. Shah

Some progress has been made in recent years in studies of programmed learning in this country. A review of work done elsewhere provided useful findings such as that combining a few minutes a day of programmed learning with conventional classroom teaching could raise student performance significantly. The difficulties and practical issues in introducing programmed learning in India and in its research are noted. There is unevenness in the availability of programmes in various fields and at various levels. Researchers work under severe practical constraints posed not only by shortage of resources but in terms of availability of time and space for experimentation in schools. Methodological problems such as difficulties in sampling, the inherent difficulty that, as Fisher pointed out, a null-hypothesis can only be disproved not proved, etc., are discussed. So also priorities in research and action.

Like all innovations in education, programmed learning is likely to meet with reluctance and even resistance. Uncritical

acceptance of a new idea or a practice is the surest way to kill it. It is, therefore, inevitable that there prevails some doubt with regard to the worthwhileness of programmed learning. Such doubt should become a starting point of research in the area of programmed learning. There have been a number of studies in the area since 1954. As Schramm (1964) pointed out no method of instruction had ever come into use surrounded by so much research activity; indeed for a time it seemed that there would be more research than programmes.

Fry (1963) attempted to provide classification of variables in a programmed learning situation and discussed how such a classification could help consumers, producers and researchers. He based his classification keeping in view the following A to Z factors:

A. Step-presentation Media (sensory input).
B. Type of Symbol used in Steps.
C. Step Characteristics.
D. Mediating Activity (between stimulus and response elements).
E. Response Mode (form of response).
F. Response Ideational Content.
G. Knowledge of Results.
H. Reward or Reinforcement Type.
I. Reward Variation.
J. Presentation Rate.
K. Branching Patterns.
L. Branching Control.
M. Repetition Practice.
N. Discrimination and Generalization.
O. Programme Length.
P. Programming Techniques.
Q. Subject-matter Characteristics.
R. Subject-matter Organization.
S. Coordinate or Supplementary Presentations.
T. Motivation Factors.
U. Environmental Influence.
V. Individual Differences.
W. Measurement of Outcome.
X. Training Efficiency.

Y. Quality of Programme.

Z. Educational Objectives (from Bloom, 1956).

It should be noted that Fry's classificatory analysis provided an outline for research in the field. An year later it was Schramm who came out with a book, *The Research on Programmed Instruction—An Annotated Bibliography.* The bibliography was prepared under a contract with the Institute for Communication Research at Stanford University by a national authority on new instructional media. The bibliography covers the review of studies completed by about February of 1963. Leith (1963) reported researches in the field under the following ten categories:

1. The efficiency of programmed instruction in comparison with classroom teaching and learning.
2. Methods of presenting programmed materials.
3. Methods of programme construction.
4. Mode of response.
5. Rate of response.
6. Method of verification.
7. The relationship of programmed learning to intelligence.
8. The scope of programmed learning.
9. Teaching methods.
10. Theoretical problems.

Kulkarni (1971) reviewed some studies conducted in India. "Most of the studies conducted in India were done keeping in view the specific situations in India." He tried to report the findings with regard to the following questions:

(i) Does instructional material prepared on programmed learning principles teach better or at least equally well in comparison to the conventional methods?

(ii) What would be or should be the teacher's role in the context of programmed instruction?

(iii) What about the attitude of the learners while going through programmed instruction?

Shah (1971), instead of surveying the whole field of researches in the area, overviewed the studies made in relation to response modes in programmed learning.

In the present paper, it is proposed to provide a conspectus of studies and the summary of broad generalizations.

It should be noted that the purpose here is to review the findings of research in the field with a view to highlight certain implications for the future of the movement in developing countries. Certain omissions in the paper should be seen in this context. Certain methodological issues have been raised toward the end of the paper so that further investigation in the field could be taken up on sounder methodological basis.

Let us begin with some descriptive studies. They include questionnaire studies, attitudinal surveys, comparative surveys and simple experiments wherein various intervening variables were not controlled.

Kulkarni and Dewan (1967) tried to apply the principles of programmed learning to television lessons. The TV presentation of a question followed by answers from the students and the feedback enabled the students to score much higher. Sarkar (1969) used programmed material for industrial training in his experiments with workers of Gujarat State Fertilizers Corporation (GSFC) and found it quite effective. Kulkarni and Mullick (1968) planned a correspondence lesson unit in Statistics both in a conventional way and the programmed way. The results were in favour of the programmed lesson. Gupta, (1968) adapted a programme in Physics and found that considerable time of subject-matter specialists could be saved if such programmes are revised on the basis of local try-outs. The cost could also be reduced by employing representation procedure which might involve group-pacing as is done by presenting the material through roll-up boards. Krishnamurthy applied programmed learning technique in the training of family planning workers and found it more fruitful and less time-consuming.

The experiments mentioned above were done with a view to trying out programmed learning procedures in a spirit of action research. Let us now turn to some inquiries made at a little higher level of precision.

Alter (1962) tested the subjects twice: immediately and again after a retention interval of 2 to 30 weeks. More intelligent students performed better on the retest than less intelligent students.

Brooks (1961) in his Ph.D. dissertation explored the relation of latency of answers to errors in programmed materials. The data

supported the view that longer latencies tend to go with errors. Latency was found to be more sensitive than error rate as a measure of difficulty.

Eigen (1963) surveyed student reaction to programmed instruction. In general, students using the programmed text had a more favourable attitude toward programmed instruction than did those using the teaching machine. Students' total attitude toward accommodated teaching, however, appeared to have no relationship to how much they have learned by the method. He concluded that it is difficult, if not possible, to conceive of a typical reaction to controversial statements about programmed instruction after a student's first exposure. Attitudes are vastly different from student to student.

Feldhusen and Eigen (1963) conducted a correlation study and inquired into interrelationships among attitudes, achievement, reading, intelligence and transfer variables in programmed instruction. The authors concluded that "attitudes of students toward programmed instruction are not consistently related to the youngsters' levels or amounts of learning.

Ferster and Sapon (1958) found no correlation between aptitude and achievement in learning programme. They reported, however, that in a mean time of 47.5 minutes, the six students learned an amount of German comparable to that presented in a first semester course.

Gagne (1962) experimented on seven ninth grade boys to explore effectiveness of learning programme designed to transfer training from component learning sets to a new activity which incorporates these previously acquired capabilities. Six of the seven boys were brought to successful achievement through ascending hierarchies to the final task goal.

Goldbeck, Shearer and others (1962) integrated programmed learning with conventional classroom teaching. They found that a few minutes a day of programmed learning integrated with conventional classroom teaching could raise student performance significantly higher than conventional classroom teaching alone. Furthermore student attitudes were favourable to programmes used this way and tended to become more favourable with longer acquaintance. This experiment has added relevance for all developing

countries like India because such an adjunctive use of programmes is going to be a practical proposition for years to come.

Hickey and Anwyll (1961) looked into effectiveness of programmed learning in industry. He used the programme on 'Procedures of Package Billing' and found 34 per cent reduction in average number of student hours needed to attain criterion level of performance.

Hickey and Laidlaw (1962) tried out programmed material on "Retail Sales and Ship's Store Management" on U.S. Navy Supply Officers. The student who used the adjunct programme saved 56 per cent of usual homework time (17 per cent of usual overall study time) in reaching performance criterion. Instructor's lecture hours were reduced to 54 per cent. Attitude was generally favourable.

In addition to the descriptive studies mentioned above, there are experimental studies worth mentioning here. It should be noted that experimental studies on response mode and personality variables in relation to programmed learning material have not been included here because they have been mentioned elsewhere in the book.

Alter, Eigen and King (1962) studied the effect of different kinds of reinforcement. In the experimental group, correct responses were confirmed by telling the students they were correct. One group was, in addition, given small trinkets for the first five correct responses, and thereafter, for about twenty five per cent of the correct responses. No significant differences in learning or test performances were found.

Angell and Lumsdaine (1960) compared a condition in which the subject was prompted on all items except in every fourth. The condition of partial prompting resulted in significantly more efficient learning. The results supported the theoretical expectation that the learner should not only be helped to respond correctly, but should also be given some practice in responding without the help of prompts.

Angell and Lumsdaine (1962) found that when students were tested immediately after finishing the programme, scores for the vanishing and the non-vanishing versions of the same programme did not differ significantly. However, scores on a delayed retention test were significantly higher for the vanishing than for the non-vanishing treatment.

Beane (1962) found that the branching programme was more efficient than the linear programme timewise. The students expressed attitudes more favourable to the linear programme.

Briggs (1961) compared self-pacing with automated pacing. One group worked at its own pace; the other group was automatically paced at the rate of about 13 seconds per item. No significant differences were found in the post-test performance of the two groups. Krumboltz (1963) studied the effectiveness of key-word response v. trivial-word response in programmed instruction v. reading of the same material in paragraph form. On immediate and delayed post-test, the key-word and paragraph-format scored about the same, and both were significantly higher than the trivial-word group.

Moore and Smith (1962) studied the effect of different kinds and amounts of reinforcements on learning. Different experimental groups were given: (a) no knowledge of results; (b) correct answer after each response; (c) a flashing light after the correct response; (d) one penny for each correct response; (e) a programme with response-blanks filled in in advance. No significant differences in learning were found among the groups.

Smith and Moore (1962) studied the effectiveness of programmed instruction by machine, programmed textbook, plus a weekly seminar v. textbook plus weekly seminar. No significant differences in achievement related to teaching machine, programmed textbook or conventional text book were found. They also studied effectiveness of teaching machine programme, programmed textbook, and conventional textbook without supplementary classwork. The machine group scored significantly higher than the conventional text group, both on immediate and delayed post-tests.

It should be noted that there are many other studies worth mentioning. Here some typical studies have been mentioned which have some relevance for situations in developing countries.

Some Broad Generalizations

Researches in the field of programmed learning have turned up some broad generalizations. These generalizations should not be taken as final. Some of the important ones are given in the following paragraphs.

Learners of all ages and stages in schools, colleges and industry show favourable attitude toward programmed material. It should be noted, however, that over a period of time the element of novelty wears off and programmes are found boring. According to Leith (1963) programmed learning, prepared and guided by well-informed teachers, is a cheap, effective mode of instruction, of which the possibilities have not been fully revealed. It has already shown itself to be a helpful adjunct to other methods of teaching. Comparisons between programmed material and traditional teaching often favour the programme, especially in terms of time. The results, however, should not be regarded as conclusive because variables like novelty effect, personality involved, and time spent are not controlled. There are reasons to believe that integrating different techniques is preferable to using only one. Smith and Smith (1966) concluded that simple teaching machines and programmed books appear to be equally effective. According to them most, but not all, of the research on step size favours small steps over large. Such research is more relevant if discrete-step programmes are to be used for initial presentation of the subject-matter. For short programme sequences, the order of frames can be randomized without affecting learning seriously.

Linear and branching styles have proved to be equally effective and have shown few significant differences. Remedial branching seems to be more effective when it is based on self-evaluation as well as on error responses.

Traditional text material proves to be as effective as or more effective than discrete programme frames in promoting learning (Smith and Smith, 1966).

There is no conclusive evidence that errors as such are detrimental to learning if they are corrected immediately and if the learner understands why he was wrong. The easy programmes do not always promote the highest achievement scores.

Covert and reading modes—not unexpectedly take less time, and are consequently, more efficient. It will be important to discover if overt responding is more efficient with the younger and less able pupil, and whether amount of previous knowledge is an important factor (Leith 1963). Shah's findings reported in the book support Leith's generalization with regard to effectiveness of covert response mode.

Whether self-pacing is important where the ability range of pupils is wide, and with larger programmes, has still to be determined, but on the assumption that pupils are ready for the course and that there is a low error rate, it seems possible to control the rate without lowering efficiency.

There are indications that far more significant phases of research in programmed instruction are under way. It is hoped that necessary modifications in the nature of programmed learning material would be made from time to time in the light of further explorations.

Some Practical Issues

Experimentation in the field of programmed learning has revealed some practical problems with reference to the situation in India. Systematic research in programmed learning has just begun in India and certain difficulties seem to be inevitable.

Paucity of Programmes

Programmes, good or bad, are a scant commodity. The Centre of Advanced Study in Education at Baroda compiled a directory of programmes (printed and mimeographed) in the *IAPL Newsletter*. Teachers and researchers the country over began to ask for some of the programmes and expressed their willingness to pay. In about 99 per cent of the queries, the answer was that the programme(s) could not be spared as there was only one copy with us.

The situation is further aggravated by the fact that in certain subjects there are very few programmes. A comparatively good number of programmes havt been prepared and even published in subjects like Mathematics and Science. The Technical Teachers' Training Institute, Madras, has published about 18 programmes on engineering subjects. These subjects, it is argued, lend themselves to programming better perhaps because they are more analysable conceptually and in terms of definable behaviours. In most of the research projects taken up in the late sixties the investigators had

to prepare the programmes before they could develop the experimental designs. The studies of Krishnamurthy and Kapadia could be mentioned here. These two investigators received training in preparing programmes and then prepared the programmes after they were registered for their doctoral work. In other words, they had to spend about an year before they could collect the data. In such a situation, research in programmed learning seems to be quite time-consuming.

The directory of the programmes also revealed that most of the programmes were prepared for the secondary school pupils. There were very few programmes for the lower primary, higher primary and college level students. Furthermore, there were very few programmes in the subjects other than the school subjects. The programmes on units related to language teaching were very few.

Quality of the Programmes

The directory of programmes mentioned above included all sorts of programmes including some which could hardly be called programmes. It also included the programmes which were never tried out either at individual or field-testing stage. Some of them were tried out without subsequent correction and validation. It should be mentioned here that the practice of giving out the validation data along with the printed programme has not yet been traditionalized. A researcher or the consumer, therefore, has no way to judge the quality of a programme before he begins to use it. Generalizations based on such a programme remain dubious and even misleading at times.

Cooperation from Schools

Most of the data in the field are collected from the schools and the pupils are given the programmes. Schramm (1964) points out that it is often very difficult to extrapolate from findings on short programmes to the conditions of classroom use. Programmes with more than a hundred frames present some problems and a researcher has to struggle hard to face them squarely. Let us take some main problems:

(a) In programmed learning the learners go at their own pace. A programme which, on the average, requires an hour actually requires an hour and a half so that the slowest in the class could also complete the programme. In some cases it is found that the slow learners require almost double the time required on the average. The situation can well be imagined when a programme is long enough to take more than three hours and when it requires to be completed in three to four sessions.

(b) Programme administration needs to be followed by administration of the criterion test. In some cases it should be preceded by pre-testing to ensure the required entering behaviour. The researcher may also like to collect retention scores of the subjects after a month or so. It is rather difficult to convince school administrators and teachers to part with so many class periods. Sometimes they might not see any obvious advantage in allowing a research worker to take so much time.

(c) Some experimental designs require randomization procedures for subjecting various groups of pupils to different experimental treatments. If the instructions are common for all the treatment groups they might be allowed to sit in the same room. There are some treatments which might require as many rooms as the number of treatments. In such a situation the problem of accommodation takes a very serious turn even if the principal is willing to cooperate.

(d) For most of the pupils, learning the programmed way is a novel experience. They seem to enjoy learning the programmed way when they take it seriously. All the same, there are situations when they do not take it seriously specially when they know that it has nothing to do with their examination and the course. There are some attitudinal problems also. For example, a programme on 'Functioning of Our Heart' is likely to be taken seriously by the ninth graders in Gujarat if the teacher has not taught the topic before the programme is given. If he has covered it, the

only alternative before the research worker is to administer the same programme to the eighth graders and collect the data. It is found that our examination-minded pupils do not take a programme seriously in a situation like this. The researcher and, in most cases, the programmer-*cum*-researcher gets frustrated if he fails to achieve the proverbial 90-90 criterion.

Administrative Problems

Preparing a programme is a time-consuming process. The programmer might take days before frame-writing begins. He has to develop, after thorough thinking, the statements for entering behaviour and terminal behaviour. He has also to develop the pre-test and the criterion test. He might like to develop these before frame-writing. He should prepare a scheme for task analysis. All these he has to do keeping in mind the specification of behaviour. He cannot afford to be verbose by using non-behavioural terms like 'understanding', 'knowing', 'developing a concept', 'appreciating', etc. The terminal behaviours listed by him are to be 'achieved' when the programme is administered and he just cannot be over-ambitious. At every step he is required to consult a subject-matter specialist who might not readily oblige him.

After the first draft is ready the programmer goes for individual testing to be followed by redrafting of the frames whenever necessary. The field tryout and editing require a lot of time. All these steps if scrupulously followed take months before the programme could go to the press.

The administrator takes some time before he could reconcile to the 'gross' delay. He is tempted to say, "why not prepare programmes covering the entire syllabus of statistics at the B.Ed. level this year?" Production emphasis, sometimes, does not go hand in hand with research in programmed learning and the net result is frustration on the part of the researcher. Sometimes the ill-informed administrators go to the length of toying with the idea of mass production of programmes without any concern whatsoever for quality.

Then there are problems of cost. An individual research worker finds it difficult to take up a study in programmed learning unless there is financial support. The cost of printing might prevent him from selecting a bigger sample as he has to manage within the stipulated amount. Moreover the press people seem to be reluctant in accepting the manuscript full of vertical and horizontal rules on all the pages. Instead of saying no, they ask for higher rates of payment. The cost factor, sometimes, gets confounded with labour factor. This may lead the researcher to go for undue compromises with regard to sampling, experimental design and even quality of the programme. He might even feel tempted to advise his colleagues not to take up programmed learning as a field of research.

The problems mentioned above should not dishearten a budding researcher who wishes to probe the field of research in this area. Many of the problems mentioned above would be solved when we have a large number of programmes on a wide range of subjects. A researcher in the field of programmed learning would not be necessarily required to develop a programme before he begins to research. He, then, would be able to collect the data on the programme(s) prepared by somebody else.

Some Methodological Issues

The practical issues discussed in the previous paragraphs give rise to the problems of methodology of research and experimental design.

Difficulties in Sampling

Time-consuming programmes coupled with tests restrict the size of samples selected for experimentation. Tests other than the criterion test are sometimes needed for controlling certain intervening variables like intelligence quotient, socio-economic status, scholastic achievement in the subject(s) concerned and the initial test score on the unit programmed, etc. Although it is quite conceivable that experimental research does not necessarily require a big sample; it does require adequate controls to maintain the experimental situ-

ation. Take for example, a research situation wherein five different forms of programmed learning material are taken to be the experimental treatments or say independent variables. Here there are three alternatives before a researcher:

(i) He may select division or a school with more than one divisions and form the five groups of pupils by random selection for administration of the programme along with the test(s) in a bigger room.

(ii) He may take more than a division in a school and go for as many replications as there are divisions in the school. This would neither require a bigger room nor would the normal divisions be disturbed. Such a practice would be more time-consuming.

(iii) He may take more than one school and go for as many replications as there are schools by utilizing bigger rooms to accommodate more than one divisions if necessary. The problem of school-to-school variance could be avoided only if he can manage to get a very big hall to accommodate pupils from all the schools.

Generalizability of the findings from researches in programmed learning remains questionable even after the problems of adequate size of the sample and maintenance of experimental situations are solved in some way. Issues such as the following crop up before one can really generalize anything:

(a) What is true for the urban schools may not be equally true for the rural schools.

(b) Effectiveness of a particular experimental treatment may vary from stage to stage; primary, secondary and university.

(c) What holds for a programme in Mathematics may not hold for that in English.

(d) What holds for short programmes may not hold for long programmes.

(e) What holds for a linear programme may not hold for a branching programme.

(f) Within the same subject also, effectiveness of an experimental treatment may vary from unit to unit. Some

content areas in a subject may be information-based while some may call for conceptual understanding.

Problems of sampling in the context of researches in programmed learning are twofold:

(a) sampling of the subjects for experimentation;

(b) sampling of the subject-matter (sample of behaviour).

Both these aspects deserve to be carefully attended to before arriving at any conclusion. Findings of research in this field should, therefore, be accepted with due reservations.

Null-Hypothesis

Fisher (1951) made the point long ago that the null-hypothesis can only be disproved; it cannot be proved. The problem of sampling is closely linked up with acceptance or otherwise of the null-hypothesis. Schramm (1964) wrote, "The numerous experiments on programmed instruction that do not succeed in disproving the null-hypothesis may, indeed, be proving that no significant difference exists, but the suspicion arises that in many cases the programmes are too short, the samples too small, the measuring instruments too dull, to pick up differences if they exist."

Leith (1963) feels that it is difficult to know in the case of many experiments, whether failure to reject the null-hypothesis occurs because there are, in fact, no differences; or because the programme is too short, the number of subjects too few, or the between-subjects variance too large.

In the field of programmed learning a large number of studies report 'no significant differences' which gives us less information than a finding of a difference. In case of a difference, a researcher can know with statistical tools the likelihood that his finding is due to chance. When he reports no difference, he has 'no logically defensible basis' as pointed out by Lumsdaine. In case of studies in programmed learning the likelihood of Type II errors seems to be much higher when a researcher accepts a null-hypothesis by marking a difference not significant.

Minimal Errors

An error in the programmed learning situation implies a res-

ponse not acceptable to a programmer. Error rate refers to 'the percentage of incorrect responses on an item, a set of items, or a whole programme.' Markle (1964) has pointed out that, 'spuriously low error rates are too easily attained by adding irrelevant easy terms, testing with a pretrained population, removing terminal items, etc.'

According to Skinner (1961), the programmer must 'keep refining his programme until the point is reached at which the answer of the average child will almost always be right.' The programmers, specially the linear programmers, seem to toy with an idea of achieving the 90-90 criterion which requires that 90 per cent of the pupils should be correct on 90 per cent of the items. Carried to its logical extreme, one can say that, in general, the more a programme is revised to produce errorless learning, the longer it gets.

Apart from theory, it is generally found that the much-talked-about 90-90 criterion is hardly achieved in practice. Achievement on the criterion test followed by a programme administration depends on the effectiveness of the programme and the nature of the test. In programmed learning situation, the criterion test items are never subjected to item selection procedures in terms of difficulty values and discriminative indices. The programmer takes into account curricular validity at the most.

It is not difficult to prepare parallel forms of the criterion test with curricular validity kept intact but with varying difficulty levels. In such a situation, the criterion should be accepted with a pinch of salt and that too in spirit. It remains a worthy ideal to be achieved at least in Indian context. In developed countries like the U.S.A., such a criterion is mostly achievable even in a normal situation of the classroom. In India where about 50 per cent of pupils somehow get through, it is difficult, if not impossible, to achieve the criterion in actual practice.

Implications For Further Research

In spite of reservations expressed difficulties listed and limitations mentioned, the fact remains that programmed learning has come to stay. Our endeavour should be to make the best of it keeping in mind the financial, socio-cultural and educational implications for

the developing countries. It is well to remember that we have single-teacher schools, teacherless schools and even schools without pupils. Buch (1972) has summarised the anomalies in Indian education as under:

1. Even though the number of schools increased, the goal of providing free and compulsory education to children in the age-group 6-14 receded further.
2. More institutions for teacher preparation came up but the quality of teacher-training deteriorated.
3. More money began to be spent for improving teacher preparation programmes but at the same time outdated practice persisted.
4. Modernization came to be discussed more and more and traditionalism continued to be practised all the same.
5. Greater pressure was put on schools to be innovative and greater was the resistance shown by the colleges of education to change.

Research in programmed learning could not prove worthwhile if these realities are ignored. In India the per capita expenditure on education and science is Rs. 16|- only. It seems reasonable, therefore, to inquire into the factors related to (1) cost, and (2) priorities.

Cost

The following points could be considered while taking up problems related to cost of producing a programme both money-wise and labour-wise.

(a) Which response-mode lends itself better to minimum printing cost due to less number of pages required?

(b) Which size of programmed book is best suited to more coverage of the matter on a page. This might have something to do with a pattern of presentation—horizontal or vertical?

(c) Which size of the book results in cost reduction?[1]

(d) What are the financial implications of using a separate answersheet for a programme?

[1]Miss G. Kapadia has prepared a programme on 'Heart'. The cost was reduced to almost 70 per cent because of proper selection of size. The advice came from the printer and not from the researcher.

(e) What about the relative durability of a programme printed on varying quality of paper?

(f) How many pupils of a particular age-group can use a programme with separate answersheet, before it gets to be rubbish?

(g) How could the cost of a programmed text be reduced by printing a large number of copies?

(h) What could be the optimum price for maximum sale for a given programme?

(i) Grant-in-aid provisions for purchase of instructional material such as programmed texts.

(j) Implications (financial as well as educational) for a private publisher coming out with programmes on a wide range of units from school subjects.

(k) Man-hours or man-days required to plan, prepare, try-out, edit and finding a programme of a given size.

(l) Which form or style of programming require less labour (linear, branching or hybrid, branier style)?

(m) Financial implications for programmes published in English, Hindi and regional languages (sales are affected by clientele).

(n) Which strategy of work is labour-saving:
— one person doing everything;
— a team of persons doing specific jobs;
— an expert assisted by hired personnel;
— a team of experts?

(o) Whether semi-programmed textbooks could be prepared in less time and with less money.

(p) Whether we could save labour and money by adapting the programmes published abroad. What are the implications (copyright, etc.) of adapting such programmes?

It should be noted that efforts to reduce the cost of production of programmes would go a long way in increasing its use. Knight rightly points out that it is not enough to show that a programme teaches; it must also do so efficiently. While thinking about cost of a programme, one must take into consideration the pupils' time and labour also. It is good to ask; could we reduce the size of a pro-

gramme without loss of effectiveness? "Several experiments have shown that programmes may be shortened without loss of effectiveness (Hawkins, 1970).

Our attempts, therefore, should be directed toward making a programme as less expensive as possible and at the same time as efficient and effective as possible.

Priorities

Scant resources call for a careful consideration of priorities. The financial inputs must bring maximum dividends in the form of improved quality of education. While deciding the content areas to be programmed one should not go ahead on *ad hoc* basis. Priorities should be assigned on the basis of research in the areas like the following:

(a) large size of clientele;
(b) content areas which are generally found difficult by the pupils;
(c) content areas which are generally found difficult to teach;
(d) basic conceptual understandings;
(e) subject areas for which there are no good teachers available.

Perspective planning in production of programmes at the national level could be done with the following points in view:

(a) Programmes on the basic concepts could be produced at national level and regional translations and adaptations may follow (like the publications of the Children's Book Trust, New Delhi).
(b) Foreign programmes may be adapted and translated on the basis of local tryouts.
(c) Experts could be commissioned to prepare programmes which are in demand.

Decision-making for assigning priority should be supported by systematic research at all levels. While discussing the implications for further research, the resources of the developing countries were kept in view. One cannot, however, ignore the fact that researches in programmed learning form a part of the ever-expanding field of

learning. Researchers in programmed learning should continue to gain from growing theorizations in the field of learning.

The possibilities of programmed learning material have not been fully revealed. All the same it has proved to be an effective adjunct to other methods of teaching. It is for researchers to prove that this is not all. We have miles to go before our teachers begin to use programmes in their day-to-day teaching. In the U.S.A., while less than 5 per cent. of schools used programmed learning in 1961, by the Autumn of 1962 33 per cent. were estimated to be making use of these methods. In India, a programme has still remained a rare commodity to be exhibited on occasions. Naik (1969) seems to be correct when he says:

> What India needs today is a large number of programmes, either prepared or adapted, in different school subjects. The best strategy to sell the idea would be to give the teacher an opportunity to use programmes in the classroom.

In a developing country like India much could be achieved with the existing resources if an attempt is made to produce programmes with minimum cost and maximum effectiveness. Research in the field would be justified only if it purports to strengthen such an attempt.

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A Study of Teacher Classroom Behaviour Across Curricular Spectrum*

M. R. Santhanam
M. B. Buch

A scientific study of teachers classroom behaviour is very significant for the understanding of pupil learning and attitudes. Research linking some aspects of teacher behaviour with some factors antecedent to teaching constitutes presage-process research. Studies linking specific dimensions of teacher classroom behaviour with curricular variables are not very many. This is, however, one of the important areas requiring deep probe. Whether teacher behaviour does or does not significantly differ as between different school subjects is crucial to the formulation of a theory of teaching.

The present study seeks to study two teacher behaviour dimensions of indirect influence (I/D and i/d), analysing the classroom verbal interaction in the six school subjects—namely, Tamil, English, Mathematics, History, Geography and Science. Based on a random sample of 32 teachers of primary and upper

*Based on the Ph.D work of M.R. Santhanam under the guidance of Dr. M.B. Buch.

primary schools in the city of Madras, the study has used Flanders' ten-category system of classroom observation. The hypothesis sought to be verified is—"Teachers differ in their influence patterns when the subject taught by them is altered." Techniques of Analysis of Variance and Student's 't' test were used.

Teacher behaviour differs, on the whole, among the six different subjects as regards both I/D and i/d concepts.

With the growing realization of the significance to pupil learning and attitudes, of the classroom social-emotional climate generated by teacher-pupil interaction the study of teacher verbal behaviour, the prime causal factor of the climate, has attracted the attention of theorists and researchers alike. In the context of efforts at developing some valid theory of teaching which at present is conspicuous by its absence, the behavioural enquiry acquires added significance.

One of the significant areas of research in this realm is what might be called 'presage-process' research. Research linking presage to process variables concerns itself with comparing some aspect (s) of the teaching process with some that existed before the teaching process started. Efforts in this direction can be perceived from two angles: (i) those studies which discuss relationships between teacher traits like, for example, teacher personality or teacher perception measures and some process variables of teaching behaviour, and (ii) those studies involving some kind of training experience of pre-service or in-service teachers and process variables.

Exploratory attempts in this direction have been carried out, inter alia, towards identifying certain presage factors responsible for significantly affecting the process factor—viz., teacher verbal behaviour and studying the nature and extent of association between them.

The works of Davies (1961), Ringness and others (1964), Wilk and Edson (1963), Simon (1966) and Smith (1965) are of pioneering nature with respect to the first kind of studies while those by Gage (1963), Bowers and Soar (1961), Soar (1966), Flanders and others (1963) and particularly the study by Allen and others (1966) shed useful light on the relationships of the second type.

Buch and Santhanam (1971) exploring the role of the sex of the teacher as a factor of teacher classroom behaviour found that male and female teachers differ significantly in respect of: (i) their capacity to generate student talk, (ii) their questioning ratio, and (iii) their content emphasis. Their study, based on the teaching of science, revealed that male teachers exhibit more content emphasis while their female counterparts demonstrate more capacity to generate student talk and to put more questions.

Concluding their review of research in the area of presage-process variables Flanders and Simon (1969) say that progress in this area is beset with a difficulty—the difficulty of relating teacher traits to performance variables. The heartening side of the picture is stated to be the promise held by some training experiences in terms of a foundation upon which new and more effective pre-service and in-service programmes like 'micro-teaching' can be built. They may also include simulating teacher-pupil interaction, quasi-simulated micro-teaching programmes and so on. There is, therefore, reason for optimism, they say.

Among the reported ventures are also those seeking to link teacher classroom behaviour with the curricular subject taught. Buch and Santhanam (1970 a,b) studied the predominant patterns of classroom behaviour of teachers teaching English while the same authors (1972) studied teacher's initiation-response balance in different subject matter areas.

Also, there are some reported studies which sought to administer in-service and pre-service programmes involving the use of interaction analysis technique with the objective of modifying teacher behaviour. The work of Flanders (1963, 1964), Storlie (1967), Moskovitz (1967), Zahn (1967), Kirk, (1967), Hough and Amidon (1967), Furst (1967), Hough and Richard (1967), Lohman et al. (1967), Hough (1967) and Zahorik (1968) provide evidence to

support the thesis that training in interaction analysis has a decisive effect on the modification of teacher behaviour.

The ultimate need for developing strategies of effective teaching is highlighted by the work of Santhanam (1971) who sought to develop some means of augmenting 'creative inquiry' in the classroom.

Studies of the presage-process type linking variables relating to the teacher and some criteria of teacher classroom behaviour have been markedly few since the studies of this type mostly sought only to link, as said earlier, some kinds of training experience on the part of teachers and process variables. The few studies that attempted to explore some non-personality variables relating to teachers like their bio-factors were pursued with reference to different criteria of teacher effectiveness.

Commonwealth Secretariat, in its Research Register (1972), reports a group of integrated studies in the area of classroom interaction analysis and teacher behaviour as being pursued at the Centre of Advanced Study in Education, Faculty of Education and Psychology, M.S. University of Baroda.*

A study reported by Buch and Santhanam (1970) highlighted the existence of significant variance across six school subjects. The study, however, was directed towards probing the English-Science pair and came across no statistical evidence to conclude that teacher behaviour significantly differs as between these two curricular subjects.

Considering the immense significance of behavioural investigations in this vital area and taking into account the highly inadequate attempts made it is felt that the problem should be tackled in a more concerted and sustained manner to yield more consistent and reliable data regarding significant relationships.

The curricular material to be taught to the students is presumably an important variable in the framework. Whether a teacher is found to exhibit different types of behaviour in the classroom while teaching different subjects is potentially significant for evolving a theory of teaching. The present study is one such attempt to fathom teacher verbal behaviour while teaching different school

*The present study itself is a part of the group of studies cited.

subjects. The subjects covered are Tamil, English, Mathematics, History, Geography and Science.

Rationale

Pupils generally find the study of English difficult and show relatively poorer performance in English than in Tamil (the regional language in Madras). To some pupils while History and Geography are relatively difficult to yet others Science and Mathematics are the Achilles' Heel. Could it be because of the varying teacher influence patterns in different subject areas ? Do different subject areas affect the teacher behaviour patterns in differnt ways ? Answers to these questions are bound to be useful.

Whatever the subject, if instruction is imparted in a democratic manner the indirect influence exerted by the teacher is believed to contribute to better learning If this were to be so, the results of investigations into the patterns of teacher behaviour in different school subjects might, perhaps, indicate the areas of pronounced 'directness' or 'indirectness'. Remedial measures might help a large number of pupils.

Scope

The study seeks to investigate the patterns of teacher behaviour by means of observing, recording, quantifying and analyzing teaching-learning process of interaction in the classroom.

Two measures of teacher indirect influence serve as the criterion variables while the subject taught is the independent variable. The study has been conducted on a random sample of teachers from primary and upper primary schools in Madras. The study being concerned with only the verbal interchange between the teacher and the pupils as also that amongst the students themselves, the non-verbal communication in the classroom is outside the purview of the study. The interaction process analysis relates to the affective domain of the teaching-learning process and not its cognitive or psycho-motor aspects.

Hypothesis

Since earlier research in this area is scanty, formulation of a hypothesis has to depend upon general observation and careful judgment. The hypothesis set up for verification is as follows—

"Teachers differ in their influence patterns, when the subject taught by them is altered."

The non-committal nature of the hypothesis is dictated by almost a complete lack of research evidence pointing to any possible relationships in this regard. Flanders (1967), while reporting the finding that Mathematics and Science are associated with higher proportion of direct influence sounds a note of scepticism and warns us against drawing generalizations based on this finding. Hence, due to the patently exploratory nature of investigation a non-committal, but nonetheless potentially significant, hypothesis is formulated. Once the hypothesis of dissimilar effect of the different subjects on teacher influence is verified the nature of the dissimilar effects could then be investigated.

The Tool

Flanders' ten-category system of classroom interaction observation is used for the study. The tool, designed to measure only the verbal communication in the classroom, is made up of, chiefly, three major components—teacher talk, student talk, and silence. Further sub-division of teacher talk into 'direct' and 'indirect' parts and of student talk into 'responsive' and 'self-initiated' parts points to the possible crucial dimensions of the classroom interaction.

The chief purpose of observation of classroom teaching-learning interaction process, using Flanders' device is to identify the patterns of teacher behaviour in terms of 'indirect' and 'direct' concepts.

The Sample

A total of 32 teachers (16 males and 16 females) were observed

twice for spells of 30 minutes each in respect of all the six subjects. In other words, a sample of one hour's teacher behaviour was collected for every teacher in every subject. All the teachers taught their respective classes all the six subjects since mostly there is what is called the 'class teacher system' obtaining at the elementary level in Madras. Such a system incidentally facilitates 'inter-subject' comparisons keeping the 'teacher' and the 'class' variables under control because they remain unaltered.

Of the 32 teachers, 16 belong to Corporation schools and the other 16 to private schools, in the city of Madras, all the teachers being selected randomly.

Method of Observation, Observer Training and Scheme of Observations

The method of observation has been in accordance with that specified by Flanders (1966). One of the chief characteristics of the system is the rhythm of making one observation for every three seconds, to be developed by the observer. The observer, in this case, was reliably trained for observations. The inter-observer reliability was found, during training spells, to be consistently above 0.85.

The scheme of observations chalked out was such that the teachers were slated for the second observation when they continued further the same unit taught during the first observation. The second observation episode was in content the continuation of the first one.

Methodology

The I/D and i/d* measures of teacher indirect behaviour in the six subjects would be treated through the techniques of Analysis of Variance and Student's 't' test.

*I/D ratio is found by dividing the sum of columns one to four by the sum of columns one to seven (in the matrix).

i/d ratio is found by dividing the sum of columns one to three by the sum of columns one to three, six and seven (in the matrix).

Analysis of Data and Discussion of Results

Since the 32 teachers in the sample have been observed in respect of each one of the six subjects there are six I/D ratios emerging for each teacher for the six different subjects. The two observation spells had been earlier added to yield one hour's data for each teacher in each subject.

Analysis of Variance—two way was applied to the data and the results are reported in Table I.

TABLE I

Summary of analysis of variance —I/D's

Source of variation	*SS*	*df*	*MSS*	*F-Ratio*
Between subjects	0.2714	5	0.05428	*9.07092
Between teachers	2.19066	31	0.07066	*11.81605
Within groups	0.92804	155	0.00598	

*Significant at .01 level.

The significant 'F' ratios as regards both 'Between Subjects' and 'Between Teachers' indicate that the differences in both the cases are statistically significant at the level of confidence indicated. The implications are that teachers differ significantly in terms of the criterion behaviour (I/D) not only among themselves but also across the different subjects. In other words, teacher behaviour differs significantly when the teacher shifts from one subject to another, on the whole.

Towards testing the hypothesis set up in this regard, these findings may be restated that teachers differ significantly in their behaviour patterns, in terms of I/D ratio, as between the different subjects. The hypothesis is thus sustained.

The verdict of significance awarded by Analysis of Variance justifies and calls for the application of Student's 't' technique for further analysis. Hence, attempt is made to identify the pairs of significantly different subjects from among the six subjects.

The six subjects yield fifteen possible pairs. Student's 't' (related sample—Difference Method) has been applied to the I/D ratios of the 32 teachers in respect of every one of the fifteen pairs. The results of the 't' test are reported in Table II.

TABLE II

Summary of "t" tests—I/D's

Subject pair	$Mean_M$	SD_D	SE_{MD}	't'
Tamil—English	.06	.11	.01944	3.08641*
Tamil—Mathematics	.06	.11	.01944	3.08641*
Tamil—History	.04	.08	.01414	2.82885*
Tamil—Geography	.02	.08	.01414	1.41442**
Tamil—Science	.02	.09	.0150	1.25786**
English—Mathematics	0	..	..	..
English—History	.10	.12	.02121	4.71475*
English—Geography	.08	.13	.02298	3.48128*
English—Science	.04	.11	.01944	2.05761†
Mathematics—History	.10	.12	.02121	4.17475*
Mathematics—Geography	.08	.11	.01944	4.11522*
Mathematics—Science	·05	.12	.02121	2.35737†
History—Geography	.02	.03	.0053	3.77358*
History—Science	.06	.1	.01767	3.39558*
Geography—Science	.04	.09	.0159	2.51572†

*Significant at .01 level.
**Not significant
†Significant at .05 level.

The individual 't' tests carried out in respect of the 15 subject pairs yield as many as twelve significant 't' ratios. The three pairs where 't' ratios are not found significant are Tamil-Geography, Tamil-Science and English-Mathematics. Of the twelve significant 't' ratios, nine are significant at .01 level and the concerned pairs are Tamil-English, Tamil-Mathematics, Tamil-History, English-History, English-Geography, Mathematics-History, Mathematics-Geography, History-Geography and History-Science. Three 't' ratios are significant at .05 level and the concerned pairs are English-Science, Mathematics-Science and Geography-Science.

For a clearer identification of the subject pairs of significant difference, a summary is given in Table III. Under each subject in its column are given the subjects with which it makes 'significantly different' pair.

TABLE III

Summary of significantly different subject pairs—I/D's

Tamil	*English*	*Mathematics*	*History*	*Geography*	*Science*
English	Tamil	Tamil	Tamil	English	English
Mathematics	History	History	English	Mathematics	Mathematics
History	Geography	Geography	Mathematics	History	History
	Science	Science	Geography	Science	Geography
			Science		

The self-explanatory summary clearly and separately identifies in respect of each subject the significantly different partners thereto. Noteworthy is the fact that History makes a significantly different subject with every other possible subject. It means that teachers differ in their behaviour patterns, in terms of I/D's, when they change from History on to any other of the remaining five subjects.

In a similar manner Analysis of Variance has been applied to the data of i/d's which are measures of teacher indirect behaviour of purely social-emotional nature of the 32 teachers in all the six subjects and the results are summarised in Table IV.

TABLE IV

Summary of analysis of variance—i/d's

Source of Variation	*SS*	*df*	*MSS*	*F-Ratio*
Between Subjects	0.27807	5	0.05561	4.00359*
Between Teachers	3.92624	31	0.12665	9.11807*
Within Groups	2.15363	155	0.01389	

*Significant at .01 level.

The significant 'F' ratios as regards both 'Between Subjects' and 'Between Teachers' indicate that the difference in both the

cases are statistically significant at the level of confidence indicated. The implications are that the teachers differ significantly in terms of the criterion behaviour (i/d) not only among themselves but also across the different subjects. In other words, teacher behaviour (i/d) differs significantly when the teacher shifts from one subject to another, on the whole.

By way of testing the hypothesis set up in this regard, these findings may be restated that teachers differ significantly in their behaviour patterns in terms of i/d, as between different subjects. The hypothesis is thus sustained.

The verdict of significance awarded by Analysis of Variance justifies and calls for the application of 't' technique for further analysis. Hence, attempt is made to identify the particular pairs of significantly different subjects from among the six subjects.

Student's 't' (related sample—Difference Method) has been applied to the i/d ratios of the 32 teachers in respect of every one of the fifteen possible pairs. The results of 't' test are given in Table V.

TABLE V

Summary of 't' tests—i/d's

Subject pair	*Mean*	*SD*	*SE*	*'t'*
Tamil—English	.024	.158	.02792	.85959**
Tamil—Mathematics	.085	.15	.02651	3.20653*
Tamil—History	.01	.16	.02828	.3536
Tamil—Geography	.05	.19	.03358	1.48898**
Tamil—Science	.01	.17	.03005	.33277**
English—Mathematics	.10	.19	.03358	2.97796*
English—History	.01	.15	.02651	.37721**
English—Geography	.07	.15	.02651	2.64051†
English—Science	.01	.16	.02828	.3536**
Mathematics—History	.09	.19	.03358	2.68010†
Mathematics—Geography	.02	.17	.03005	.66555**
Mathematics—Science	.08	.18	.03181	2.51493†
History—Geography	.05	.15	.02651	1.88608**
History—Science	.01	.13	.02298	.43516**
Geography—Science	.08	.17	.03005	2. 68222†

*Significant at .01 level.
**Not significant
†Significant at .05 level

The individual 't' tests carried out on the 15 possible pairs yield only six significant 't' ratios. In the case of two pairs the 't' ratios turn out to be significant at .01 level of confidence and the pairs are Tamil-Mathematics and English-Mathematics. In other words, the patterns of teacher behaviour (i/d) differ significantly at the level of confidence indicated when the teachers move from Mathematics onto Tamil and English. The 't' ratios in the case of four other subject pairs indicate that they are significantly different at .05 level of confidence. The concerned pairs are English-Geography, Mathematics-History, Mathematics-Science and Geography-Science.

The remaining nine non-significant 't' ratios signify that there is no statistical evidence to conclude that teachers differ in their behaviour (i/d) patterns when they change from one to another subject among the pairs concerned.

Conclusion.

The above findings boil down to the following conclusions:

Teacher differ significantly in their behaviour patterns (both I/D and i/d) when the subject taught by them is altered, in respect of the following subject pairs.

(i) Tamil-Mathematics
(ii) English-Geography
(iii) Mathematics-History
(iv) Mathematics-Science
(v) History-Geography
(vi) Geography-Science.

Teachers differ significantly in their behaviour patterns (in terms of only I/D) when the subject taught by them is altered in respect of the following subject pairs.

(i) Tamil-English
(ii) Tamil-History
(iii) English-History
(iv) English-Science
(v) Mathematics-Geography
(vi) History-Science.

Teachers differ significantly in their behaviour patterns (in terms of only i/d) when the subject taught by them is altered in respect of the following subject pair only.

English-Mathematics.

The aim of research on teacher behaviour should help an educator to devise ways and means of modifying teacher behaviour. If this is to be achieved it is necessary that inquiries are undertaken about the correlates of teacher behaviour. Recent thinking further points to the need for more sustained research on the climates prevailing in the school, teachers' and principals' role perceptions, etc. This latter category of variables can be considered as institutional variables.

Further attempts in this direction, it is felt, should be not only towards seeking more evidence on the results reported but also towards studying the deeper relationships involving instructional objectives and teacher behaviour variables, stretching across the subject spectrum. Perhaps, more useful light may be shed in such research.

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Stabilization of Abilities during Adolescence—I

(A Cross-Sectional Study)

*Atmananda Sharma**

This is the first part of the report of a study conducted on 2628 Delhi school children from 5 schools, reading in classes eight, nine, ten and eleven belonging to all courses, humanities, science and commerce, representing a wide range of parental occupations and socio-economic levels. Tests of verbal deductive reasoning, numerical ability, spatial clerical speed and accuracy and mechanical ability were administered. The growth curves or better age progress curves for the six abilities showed different characteristics. In the first two, there was similarity with brighter groups starting at a higher level but growing at a slower rate. The growth curves for numerical, clerical and mechanical had almost similar characteristics. Rates of growth of pupils of different degrees of brightness was almost equal and, therefore, the differences observed in the beginning at the eighth grade were maintained throughout the three-year period. The growth

*The author was assisted by Shrimati Shakuntala Bhatia, M.S. Savita and P.C. Bansal in the collection and scoring of the data. K.P Garg was mainly responsible for the analysis of the data. Shib K Mitra, Perin H. Mehta, Harold Webster and the members of the departmental committee offered advice and comments.

curves of spatial ability indicated that brighter groups not only began at a higher level but grew at a faster rate so that the differences between brightest and dullest had increased by eleventh grade. Indications given by the growth curve for the modal age group are slightly different.

A knowledge of psychological development and change throughout the life span in relation to the rapidly changing social, economic and cultural environment can contribute in a very practical way to better human development. It may help a person in seeking more adequate self-understanding and in meeting present and future problems; it may help a student of psychology to see various phases and specialities of psychology in long developmental perspective; it may help the counsellor and psychologist to identify the emotionally disturbed or mentally ill by appreciating the significance of deviation from the usual patterns of development; it may help the psychiatrist in his preparation to meet the needs of a sick child knowing that a sick child may regress to an earlier stage of development, it may help a teacher in nuturing and guiding the development of masses of varied potentialities into whole and unique personalities and it may help an educational planner to provide a psychological basis of education.

In our school system, at one point or another, pupils are called upon to choose among several different curricula. While it is true, of course, that these are educational choices, they are also vocational; for different curricula lead to different kinds of occupations. They lay the foundations of personal and social adjustments too.

How ready are these pupils, on entering higher secondary school to make such choices? Are their aptitudes, interests, and personality traits sufficiently developed and stabilised? Are strengths and weaknesses in abilities relatively permanent? Have they reached a stage of development at which they can know themselves well enough to make such decisions? This investigation seeks to answer the question of stabilisation of abilities and their patterns

in the adolescent period of higher secondary school children even while recognising that the answers provided at this time can be only tentative.

ABILITIES : NATURE AND DEVELOPMENT

Nature: Competence in any area whether it be solving a practical problem, whether it be of accurate information in one's specific field of knowledge depends upon interest in the activity and needed skills and information, but more than these is needed the potential ability to acquire a satisfactory degree of competence.

Man has been aware of and has directed his attempts towards understanding and analysing this potential ability, called intelligence, from time immemorial. However, there has been a great deal of controversy over its more precise definition. No one set of words is universally accepted to define the concept of intelligence nor is there complete accord among those who have investigated its nature and structure. The most controversial—issues in the words of Vernon (1960) are two: firstly, "Is intelligence a unitary faculty of the mind? Are human diverse cognitive capacities—perceiving, thinking, imagining, learning, recalling together with special abilities along different lines—all functions of this intelligence or are they relatively or completely independent? Secondly, is intelligence inborn or innate, inherited from our ancestors, and therefore constant throughout life (apart from its natural growth during childhood and eventual decline with senescence); or is it partly or even wholly dependent on upbringing and education?

Although upto this date there is no single definition of intelligence which is acceptable to the majority of psychologists and which might provide a sound basis for constructing intelligence tests yet the areas of agreement are greater to-day than those of disagreement. The reason is that the psychological knowledge of intelligence is based on, and limited to the mathematical and statistical analysis of quantitative data derived from so-called intelligence tests.

In United Kingdom, during 1900-30, Spearman (1927) showed that neither the monarchic (a single capacity of general intelligence) nor the oligarchic (a number of separate powers or facilities) theo-

ries of mind could explain observable facts. He advocated the 'two factor' theory which could explain the tendency for all abilities to overlap to some extent and yet to show considerable unevenness. All intellectual activity is dependent primarily upon and is an expression of general factor 'g' common to all mental activity and each mental activity has its own specific factor 's'.

In the United States, leading factor analysists such as Holzinger, Thurstone, Gilford and their students have identified group factors that have been interpreted as differential abilities. Thurstone (1938) found nine psychologically interpretable factors that he referred to as primary mental abilities; the word 'primary' indicating first found rather than an 'ultimate' or final set of group factors. Making use of the factor analytic model of Thurstone, Guilford (1947) in the psychological research units of the U.S. Army Air Force during World War II not only found several psychologically interpretable factors that had not appeared in other investigations, but also demonstrated through analysing the pass-fail training criterion along with the tests of various other batteries that different types of ability were associated with success in such air crew positions as those of navigator, fighter pilot and bombardier. Thus the development of differential ability tests provided a way to determine a particular combination of abilities that are important in certain jobs, or in given academic subjects and once such combinations are located corresponding tests that yield relatively pure measures of these abilities can be constructed.

However, it is impossible to specify the number of distinct abilities that may exist in view of problem of definition, the presence of varying criteria for achieving psychologically meaningful interpretations in factor analytic procedure and the probable interactions that arise in certain combinations of abilities. French (1951) presented a list of what appeared to be about 50 factors, of which 30 or 40 could be viewed as representing different abilities.

Extensive research indicates that a certain minimum number of abilities have been established well enough to be listed: (a) verbal comprehension, (b) numerical ability, (c) reasoning, (d) perceptual speed, (e) spatial orientation, (f) spatial visualisation, (g) word fluency; and that these abilities develop and stabilise during twenties.

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Mental Development

Mental growth is usually studied by plotting the scores of 'general intelligence' (as measured on such current intelligence tests as the Stanford Binet, Wechsler Scales, Army Alpha, and many others that are designed to sample wide spectrum of abilities) against age. A life span curve based on scores from these tests shows very rapid growth in infancy, rapid but somewhat more moderate growth throughout childhood, slowing during the late teens to the early twenties. After this the direction of the curve varies with the tests used and the populations tested. Although this curve of intelligence may be looked on as a general pattern of mental growth, it is not built from a simple unitary function that augments by mere accretions. As in development generally, mental growth is a function of an organism in the process of differentiation and organisation, both structural and functional, which occur as the organisminteracts with its environment. At first growth and differentiation are rapid, and consequently the nature and composition of mental functions change continuously and rapidly during infancy. They become fairly stable in their nature but continue to grow steadily throughout childhood, then change gradually in adulthood, usually with an accelerated differential decline in senescence. In other words, when growth changes are most rapid, we are also more likely to find rapid shifts in the nature and relative contributions of the component mental processes.

Mental Development in Infancy and Early Childhood: The earliest behaviour development cannot be characterised as mental (Bayley, 1951). During the first four to five months it is predominantly sensoryneuro-motor (Gesell, 1954 & Pratt, 1954). Between twelve and eighteen months, generally the child begins to use language meaningfully and to develop an understanding of meanings of words as well as of gestures, facial expressions and the like. This is regarded as the beginning of mental or intellectual functioning. The correlations of intelligence test scores at two years with scores at later stages remain significantly positive, approximately of the order of .50. By six years of age the test scores become fairly predictive of the general level of intellectual performance expected of an individual. The correlation between Stanford-Binet I. Q's at six years and at 12 to 18 years are generally of the order of .80.

Mental Organisation in Childhood and Adolescence: During childhood and adolescence the different mental abilities appear gradually to become more and more independent with increasing age. The general factor accounts for a distinctly smaller proportion of the total amount of individual variation while group factors play an increasingly predominant part. It seems probable that maturation has much to do with the differentiating process, but increasing experience and diverging interests must also contribute heavily. There is biological and neurological evidence to support the view but satistical evidence appears to be the largest and most useful for educational psychologists—Balinsky (1941), Burt (1954), Garrett, Bryan & Perl (1935), Mukerjee (1962), Peel and Graham (1951), Ruth Wright (1939), Swineford (1948 & 49), Vernon (1960).

Stability of Mental Abilities and Organisation

Although the nature of mental abilities differ at different periods of life and the rates of changes vary both with age and specific mental functions but some periods of growth are characteristically more stable than others. Obviously stability is inversely related to change. Empirically a stable characteristic is not significantly different in its magnitude from one point of time to another; or one can also say it is consistent from one point in time to another. The minimum time and the minimum difference in magnitude or the minimum consistency level may be defined on a scale of time, say one year, the difference in scores is not significantly different at one per cent level and the correlation coefficients are .75 and above respectively. Thus a stable characteristic may be one that may be different quantitatively as also qualitatively at the two time points if the change is predicatable to some minimum degree. The same is true of the stability of mental organisation or pattern of abilities.

According to Bloom (1964) non-reversibility and negative acceleration also characterise stability. Non-reversibility means that the growth which has taken place once is not lost later on and negative acceleration refers to rapid growth in the beginning and slower growth later on. A problem related to these two attributes is the compensation for less than normal growth at one period by greater growth at a later period. It appears doubtful that the growth deficits

can be fully made up at a later period but a great deal of research is needed to know the conditions under which they can be compensated for.

Similarly, there is little data to understand the nature of growth changes in mental organisation. Even in the Western countries, no studies have been planned and carried out with the specific purpose of investigating the problems of stabilisation of abilities, interests and personality traits, yet educationists and psychologists have derived evidence from various sources which can be classified under: (1) longitudinal studies (2) follow-up studies of a particular sample on a small number of variables, (3) experimental studies on the effect of educational or other variables, (4) longitudinal data maintained by educational institutions, and (5) data collected for the standardisation of test batteries.

The major longitudinal studies that have attempted to secure a long variety of measurement on a well defined sample are the Iowa Studies by Baldwin (1921), the Chicago Study by Freeman and Flory (1937), the California Growth Study by Macfarlane (1938), the Harvard Growth Study by Dearborn and Rothney (1941), the Berkely Growth Study by Jones and Bayley (1941), the Michigan Study by Olson (1955). In these studies the tools used for investigating the growth of intellectual ability were such as to provide a single score like the I.Q. or M.A. and therefore provided little evidence about the stabilisation of abilities like v, s, n, m, etc.

Longitudinal and Cross-Sectional Approaches

Investigators have used longitudinal or cross-sectional approaches to study the process of mental development. A longitudinal approach which requires studying the same individuals year after year has many practical difficulties. Besides the long span of time involved, there are educational, social, economical and administrative difficulties. Some students fail in a class and some discontinue studies on pecuniary and other grounds. Some students migrate to other schools in quest of courses not available in their original schools or merely because their parents or guardians are transferred from one place to another; the cooperation between the investigator

and the schools and students is likely to be lessened in case of final year students and thus the number of students lost to the study during the interval may be considerable. Consequently, the later follow-ups are also likely to be selected with regard to stability of residence and continued cooperation with the investigator. Subjects thus selected in terms of those conditions may in time show other characteristics related to cultural level of the home interests, attitudes and the like. Therefore, generalisations from a longitudinal sampling to the total population must be made with considerable caution and with due regard for the selective factors which may have operated in the particular situation. At worst, however, such selection limits the scope of the results, though it does not invalidate them if the population to which they apply is clearly specified. Secondly, continued participation in the study itself may affect the subjects' behaviour. Practice in taking tests, repeated contacts with the investigator and his colleagues, identification with a special group, and such similar factor may influence the subjects' tests performance, attitudes, motivation, emotional adjustment and other characteristics. Hence, many studies on age and experience differences have resorted to cross-sectional procedures. For example, groups of students ranging in age from 13 to 16 years or leading in grades VIII to XI are tested simultaneously and the mean score of each age group or age cum grade are compared or plotted against age. It is assumed that these means indicate the normal course of development and that they approximate closely the scores that would have been obtained if, say, the 13-year-olds had been retested annually until they reached age 16.

Such an assumption can be questioned on various grounds like selectivity, differences in experiences etc. Higher secondary students reading in class XI, for example, are a more highly selected group than students reading in class IX since the academically poor students tend to drop-out in the course of their high school work. Had the same subjects been tested in the ninth and eleventh classes of the higher secondary school, the mean gain in score might thus have been much smaller. Secondly, in a 'Cross-sectional' approach the experimental backgrounds of different age groups may not be comparable. This is especially evident, if comparisons are made between widely disparate age groups. For example, the difference

between present day 50 year olds, present day 25 year olds and present day 13 year olds cannot be attributed entirely to factor associated with age. At the time when to-days's 50 year olds were 13 year-olds schooling was not only poorer but different, opportunities for certain types of activity were non-existent, and many social attitudes were quite different from those current today. Such comparisons are thus complicated by the fact that older and younger groups were brought up under different conditions, owing to general cultural and socio-economic changes which are constantly occurring.

Because of the various advantages and limitations of two approaches—longitudinal and cross-sectional, combinations of these approaches may be desirable. One experimental design (Anastasi, 1958) involves the cross-sectional testing of different age groups, supplemented by short-range follow-ups. For example, 13 year old and 15 year old children may be tested three times over a two year period. The performance of both groups at age 15 as well as the trend of retest changes within the two group provides a check on the comparability and continuity of these two age samples. If such comparability is established data obtained on the two groups over the two year period can be treated jointly so as to reveal changes between the years 13 to 17. Another research procedure (Anastasi, 1958) requires the combination of cross-sectional surveys with longitudinal studies of populations which makes it possible to readily separate age changes from cultural changes. For illustration, if 25 year olds and 50 year olds are tested in 1965 and similar samples of the same ages tested in 1990, any difference in score between 25 year olds and 50 year olds in 1990 could be attributed to cultural change. Difference, between 25 year olds and 50 year olds tested simultaneously in 1965 or 1990 will reflect age changes together with cultural changes specially differences in conditions of upbringing. Finally comparison of 25 year olds in 1965 with 50 year olds in 1990 will indicate the joint effects of age and intervening cultural changes which may have modified the subjects behaviours after age 25. It is worth mentioning that even if the same sample of 25 year olds tested in 1965 were retested in 1990, intervening cultural changes could not be separated from age changes unless

comparable data were available on groups of the same age tested on the two occasions.

In the present investigation, another combination of 'longitudinal' and 'cross-sectional' approaches have been attempted. Students reading in classes VIII, IX, X and XI in 1963 were the subjects of cross-sectional study, whereas the eighth class students were tested year after year for four years till they left the higher secondary schools in 1966-67. This report presents the results of cross-sectional study.

Aptitude or Ability

The use of these terms in relation to each other is not entirely consistent as is evident from a consideration of such well-known texts as those by Anastasi (1954), Cronbach (1955) or Thorndike and Hagen (1955). An 'aptitude' is defined as a persons capacity or hypothetical potential, for acquisition of a certain more or less well defined pattern of behaviour involved in the performance of a task with respect to which the individual has had little or no previous training. On the other hand, 'ability' is viewed as the current performance of an individual on a task near his maximal level of motivation a task with respect to which he has had a limited amount of more or less loosely structured experience. The aptitude measure serves primarily to indicate what an individual will be able to learn, and the ability measure presents evidence of what the individual is able to do now if he applies himself. In this study the term ability is used when thinking of traits in the static sense, while aptitude is used when it has to do with mental traits as predictors.

II. Purposes and Procedure

The main purposes of the study were:

1. To study the developmental changes in the magnitude of six mental abilities: verbal, reasoning, numerical, spatial, perceptual (clerical speed and accuracy) and mechanical and their stabilisation in the adolescent period of higher secondary school children.

2. To study the pattern of abilities and its stability in respect of higher secondary school children of different levels of brightness.

Problems for Investigation

The problems taken up for investigation were:

1. Are there variations in age and brightness of children reading in the same class?
2. Do the abilities stabilise during the adolescent period, that is, at what age the plateau emerges in the growth curve of an ability?
3. Are the rates of growth of different abilities for different levels of brightness different?
4. Are the abilities differentiated during the adolescent period?
5. Is there psychological evidence to justify a belief that children at delta class (13+) can be sorted according to their abilities into four-five special types each suited to the type of stream of secondary education?
6. If a child belongs to one type at 13+, is he bound to remain the same in later years? Are strengths and weaknesses in abilities relatively permanent? The question is one of determining the standing of an individual in a group from previous knowledge of his standing in the same group regardless of the changes in the level of accomplishment. If changes or errors may sometime occur how frequently they may do so?

Selection of Schools

The evidence for differentiation of abilities and the stability thereof is usually presented in terms of magnitude of correlations obtained between various test scores at different stages of development. But we know that the magnitude of correlation is affected by several factors, both intrinsic and extrinsic, and are, therefore, open to obvious criticism. As children grow older, simpler functions mature earlier than more complex. A specificity of function, therefore, may be affected through differential rate of growth and subsequent differences in time of maturation. Again it seems probable that specificity in achievements may result from increasing divergences in training, interests, incentives rather than of an internal and spontaneous maturation. The adaptive behaviour of a young child is more amorphous (more nearly on the same performance level) than is that of the adult. Furthermore, a child's school

achievements depend to a greater degree upon facility and understanding in reading and hence are more variable than the achievements of a college student in whom reading habits have become highly mechanised. All of these factors probably operate in the direction of specificity, i.e., of reducing the r's among tested abilities. It is worth noting, also, that in studies of college students one always deals with highly selected groups. The factor of selection with the resultant narrowing of the ability range, would alone reduce the intercorrelation at the upper age levels even if there was no real tendency for abilities to become specialized with age.

To avoid the danger of greater selection at upper than at lower age levels, it seemed wise in the present study to work with groups not too widely separated in age. At the same time since we were concerned with the effect of age change upon abilities, we wanted to employ groups far enough apart on the growth curve to make age a real factor. Further, to make the sample as representative as possible the groups should come from schools which represent all the three levels of efficiency—good, average and below average—as judged from their last three years results at the Higher Secondary Examination. Thus five boys' schools of Delhi representing the three levels of efficiency and having approximately the same number of students reading in classes eight, nine, ten and eleven were selected for the study.

The Sample

All students of 5 schools* reading in classes eight, nine, ten and eleven numbering 2,628, were included in the sample. These students belonged to all courses: humanities, science and commerce, and the parental occupations and socio-economic levels represented a wide range.

The total sample was divided into grade-cum-groups, i.e., stu-

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*Harcourt Butler Higher Secondary School, Reading Road, Government Boys Higher Secondary School No. 2, Vinay Nagar, Municipal Corporation Higher Secondary School, Rouse Avenue, Government Boys Higher Secondary School, Kingsway Camp and Government Boys Higher Secondary School No. 1, Qutab Road in New Delhi.

dents in a class were grouped according to their ages and these age-cum-grade groups were, therefore, homogeneous with regard to age and grade. The details of the grade-cum-age groups are shown in Table (i) Appendix I. However, as is evident from this appendix, some of these groups had few students and, therefore, 225 students belonging to these small groups were excluded from the sample. Thus in each grade five age groups were retained.

Further it was noticed that the data in respect of 743 students was incomplete in some respect due to various reasons, such as being late in the first period, being absent for the whole day due to sickness or some other important work. But these students were not truants or victims of some other bad habits. The incomplete data in respect of these 743 students had also to be discarded.

Thus, the total sample was reduced to 1,660 students, the details of which are shown in Table (ii) Appendix I. However, the exclusion of 968 cases from the sample did not affect the nature of the distributions of ability scores; the central tendency and dispersion of the different ability scores remained unaffeced. (Table iii Appendix I).

The Tests

Firstly, to secure more direct and convincing evidence, it is desirable to use tests which measure mental abilities as such and which are, therefore, unlikely to be much affected by school conditions. The tests should also be such as to elicit group factors of special types, namely, tasks or problems which depend as little as possible on general intelligence and as completely as possible on some particular form of mental process. It is also implied that each type of factor must be represented by at least two tests. Secondly, the tests should be relatively pure for such tests only provide a broad coverage of human traits in an economical and meaningful manner. Thirdly, the tests should be operationally valid i.e. the tasks required by a test are adequate for the measurement and evaluation of certain specified and defined psychological operations. Fourthly, the tests should allow a discrimination over a wide range. The tests without being too lengthy for the time available should be suitable both for the dullest in the younger group

and for the brightest in the older. Such tests will, not only eliminate differences in standard deviation at various age levels (for all cognitive tests the standard deviation tends to increase in rough proportion with age (Burt, 1954) but will reduce the chances of a distribution from being skewed). Moreover the use of same tests at all age levels would permit comparison of correlations among the same abilities from one age level to the next, and thus would reveal any tendency toward closer or more divergent relationships as age increased. Fifthly, the working time for any test should not be long, besides the reluctance of school authorities in giving a considerable amount of pupils the students themselves become non-serious if they are subjected to long periods of testing. Lastly the tests should be Indian that is they have been developed for Indian subjects or have been adapted for them.

Keeping in view the above considerations only six abilities as measured by the folowing tests could be selected for this investigation.

Ability	*Test*	*Author/Publisher*
V	Verbal	Predictive Battery of the Differential Scholastic Aptitude (1952), University Training College, Nagpur.
R	Deductive Reasoning.	"
N	Numerical Ability	Differential Aptitude Tests, Psychological Corporation, America.
S	Minnesota Paper Form Board, Series AA.	*Manasayan*, Delhi.
C	Clerical Speed and Accuracy	Differential Aptitude Tests Psychological Corporation, America.
M	Knowledge of Tools, Mechanical Comprehension and Mechanical Adaptability.	A Battery of Mechanical Aptitude Tests by Dr. A Sharma

A brief description of the tests is given below:

1. *Verbal*: Thus is the second test of the Predictive Battery of Differential Scholastic Aptitude, University Training College, Nagpur. The test measures verbal ability through 35 items of synonyms and 35 items of antonyms with six response choices for each item. The exact time for the test is 20 minutes and the raw score is obtained

by using the formula Right-Wrong/5, the maximum possible score is 70.

2. *Reasoning*: This is the fourth test of the Predictive Battery of Differential Scholastic Aptitude, University Training College, Nagpur. The test measures deductive type of reasoning through fifty scrambled sentences. The mental operations involved are comprehension and judgement. The words have to be mentally arranged in a meaningful form and then a judgement is to be made whether the statement is right or wrong. The exact time for the test is 12 minutes and the raw score is obtained by using the formula: Right-Wrong, the maximum possible score is 50.

3. *Numerical*: The test is one of the Differential Aptitude Tests, Psychological Corporation, New York, America. The items are designed to test understanding of numerical relationships and facility in handling the numerical concepts. The problems are framed in the type which is called arithmetic computation with five response choices. The exact time allowed for the test is 30 minutes and the raw score is obtained by using the formula: Right-Wrong/4, the maximum possible score is 40.

4. *Spatial*: This is the familiar Minnesota Paper Form Board, Series AA. The item type devised for this test is made up of a 'stem' and five possible choices from which to select an answer. The stems are the disarranged parts from two to five in number of a geometric figure. The responses are the assembled geometric figures, only one of which could be made by putting the parts of the stem figure together. The problem is to select the figure which corresponds to assembled parts, which must sometimes merely be mentally pushed together in order to make an appropriate whole and sometimes mentally turned round or over. The items, therefore, resemble those of the real form board except that there can be no trial and error work with the paper form board, the matchings of spaces and sizes must be done mentally. The exact time allowed for the 64 items is 20 minutes and the raw score is obtained by using the formula: Right-Wrong/5, the maximum possible score is 64.

The validity studies indicate that it is one of the most valid tests of the capacity to visualise and manipulate objects in space.

5. *Clerical Speed and Accuracy*: The test is one of the Differential Aptitude Tests, Psychological Corporation, New York,

America. The items, number and letter combinations, are designed to measure speed of responses in a simple perceptual task and provide a situation which approximates the elements involved in many clerical jobs. The student first must select the combination which is marked in the test booklet, then bear it in mind while seeking a group of similar combinations on a separate sheet and having found the identical combination underline it. The objective of the test is to measure speed of response. The exact time allowed for the test is 6 minutes, 3 minutes for part one and 3 minutes for part two, each part containing 100 items.

6. *Mechanical*: The Mechanical Ability (M) was measured by using the three tests (Mechanical Knowledge, Mechanical Comprehension and Mechanical Adaptability) of the Battery of Mechanical Aptitude Tests by A. Sharma. The Mechanical Knowledge Test Measures an individual's knowledge of the functions of tools, the purposes for which they are used rather than their names or by whom they are used. The items for the test consist of commonly used tools of a carpenter, mason, gardner, electrician, or in the household work. The tools have been presented in groups of six on which three questions about their functions have been asked. The raw scores are obtained by using the formula Right-Wrong/5, the maximum possible score is 30.

The Mechanical Comprehension Test measures understanding and application of scientific and mechanical principles. The items require comprehension of the nature of operation and efforts of various physical principles rather than knowledge of specific tools or items of eqquipment and their uses. Each item provides four responses in the form of pictures exhibiting one or more objects, physical situations or mechanical relationship about which a question permitting a categorical answer is asked. The principles underlying these questions include movements of gears, leverage, force and motion, light, heat, density and pressure. The raw score is obtained by using the formula Right-Wrong/3, the maximum possible score is 30.

The Mechanical Adaptability Test is essentially a measure of the individuals' background in fields of science, scientific applications and related activities. The test consists of two parts. The first part is essentially a true false examination, the responses to

the items are recorded under columns labelled 'Yes', 'No', 'Don't know'. The second part consists of multiple choice of items each question containing four alternatives. The raw score for the first part is obtained by using the formula Right-Wrong|2, the maximum possible score is 20 and the raw score for the second part is obtained by using the formula Right-Wrong|3, the maximum possible score is 10.

The scores of the three tests are then combined to give the Mechanical Ability Score (M).

Testing Schedule

The tests were administered by trained testers of the then Central Bureau of Educational and Vocational Guidance (since incorporated into the Department of Educational Psychology and Foundation of Education, NCERT) in school hours during September-November, 1963. The testing programme for one class section was spread over three sessions, each two hours long. These sessions were held on three consecutive days. In the first session, four tests—verbal, reasoning, numerical, and clerical, were administered in the order mentioned. In the second session, spatial and three mechanical aptitude tests were given. The third session was used for administering interest inventories for the longitudinal study.

Scoring

The data was punched on cards at the University Grants Commission and was scored on machines by the International Computers and Tabulators, New Delhi.

Analysis of Data

The characteristics, namely the measures of skewness, kurtosis, central tendency and variability of all the age cum grade distributions of different abilities were worked out.

The age and brightness variations amongst boys of the same grade were studied by undertaking the "analysis of variance".

The developmental changes in the different abilities for different

levels of brightness were studied graphically as well as by testing the significance of difference between means of two consecutive age-cum-grade groups.

The test reliabilities for different age-cum-grade distributions of the six ability tests were worked out by using the KR-21 formula.

The disparity among abilities was studied by using the Kelly's method (1923) of determining the proportion of differences in excess of chance proportion, that is, differences not attributable to either unreliability of the tests or to the overlapping of measurement by them.

The changes in the patterns of abilities for different age-cum-grade groups were studied. An analysis of variance test for the existence of group psychometric patterns and configurations of test scores was used.

III. The Data

Age Distribution

The age restrictions imposed on the admission of pupils to schools and to examinations by the Directorate of Education, Delhi Pradesh makes one think that the classes will be almost homogeneous with regard to age. A pupil who had not attained the age of sixteen years on first day of September in a year was not permitted to take the higher secondary examination. Therefore, one would expect all the pupils reading in class eleven to be of sixteen years or more in any academic year, the modal age for classes ten, nine and eight was expected to be fifteen, fourteen and thirteen years respectively and at the same time all the pupils were expected to be above the modal age in any class. However, the data under consideration showed great variations of age in each grade. There were pupils of lower as well as higher ages than the modal age for a grade. Table 1 and Figure 1 show the distribution of ages of pupils in the four grades.

It is obvious from Table 1 and figure 1 that the variability of ages in each grade was large and that the overlapping of ages among grades was also great. Pupils of twelve and thirteen age groups were found in the grades VIII, IX and X. Also every grade

TABLE 1

Distribution of Chronological Ages in Classes VIII, IX, X & XI

Class	VIII		IX		X		XI	
Ages	*N*	%	*N*	%	*N*	%	*N*	%
10+	1	0.13	—	—	—	—	—	—
11+	15	1.96	1	0.14	—	—	—	—
12+	177	23.08	32	4.38	1	0.16	—	—
13+	251	32.72	101	13.84	15	2.41	—	—
14+	152	19.82	261	35.75	78	12.52	3	0.59
15+	114	14.86	157	21.51	159	25.52	50	9.84
16+	22	2.87	106	14.52	155	24.88	144	28.35
17+	22	2.87	52	7.12	92	14.77	127	25.00
18+	7	0.91	9	1.23	67	10.75	115	22.64
19+	2	0.26	7	0.96	14	2.25	46	9.06
20+	1	0.13	3	0.41	14	2.25	12	2.36
21+	1	0.13	—	—	26	4.17	8	1.57
22+	2	0.26	1	0.14	1	0.16	3	0.59
23+	—	—	—	—	1	0.16	—	—
Total.	767	100.00	730	100.00	623	100.00	508	100.00

had pupils of age, fourteen plus, fifteen plus, sixteen plus, seventeen plus, eighteen plus, nineteen plus and twenty plus.

Score Distribution

The frequency distributions of different ability scores for variolus age-*cum*-grade groups are given in appendix III. The means, standard deviations, V_1, $V_1/SE(V_1)$ and V_2 for the distribution of different abilities are set out in Tables 2 to 7. Figures I shows the percentage distribution of students in different classes.

Age Variations

If one goes through the column downwards in any of the Table 2 to 7, the mean scores go on decreasing within each class while the age goes on increasing. For example, in Table 4 for class VIII, the mean scores of pupils of ages 12+, 13+, 14+, 15+, and 16+ are 10.44, 8.77, 6.78, 5.56 and 4.20 respectively and this trend

FIGURE 1

Agewise percentage distribution of student in classes VIII, IX, X & XI

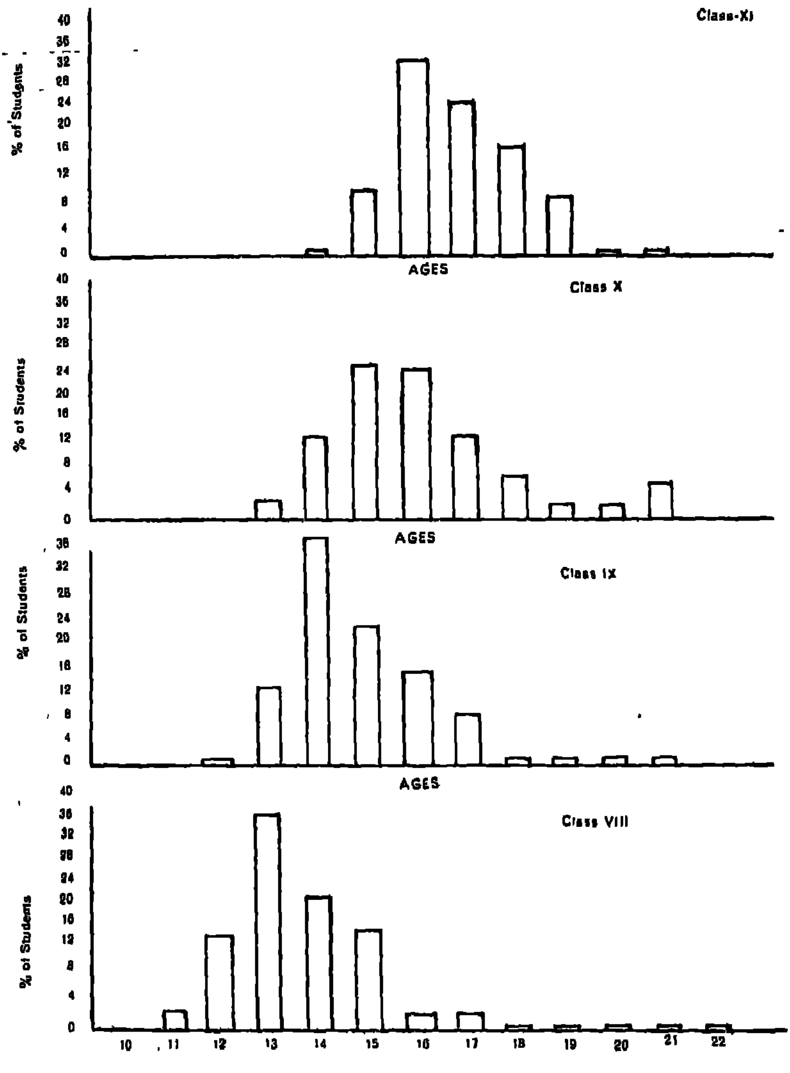

TABLE 2

VERBAL ABILITY

Agewise Means, Standard Deviations V_1, $V_1/S.E.V_1$, V_2, and Number of Students reading in Classes VIII, IX, X and XI.

Age	*Class*	*VIII*	*IX*	*X*	*XI*
12+	Mean	33.65			
	S.D.	12.47			
	N	(88)			
13+	Mean	28.43	33.52		
	S.D.	13.89	13.32		
	N	(199)	(69)		
14+	Mean	22.08	31.32	40.47	
	S.D.	10.89	13.67	11.75	
	N	(123)	(190)	(59)	
15+	Mean	21.01	27.42	36.68	42.18
	S.D.	11.89	12.58	11.85	12.28
	N	(96)	(119)	(108)	(31)
16+	Mean	17.00	29.34	33.91	39.34
	S.D.	9.13	11.80	10.07	9.76
	N	(15)	(77)	(102)	(96)
17+	Mean		23.93	34.41	38.87
	S.D.		10.56	10.89	13.65
	N		(44)	(58)	(75)
18+	Mean			28.00	37.19
	S.D.			8.10	10.28
	N			(30)	(53)
19+	Mean				37.54
	S.D.				10.88
	N				(28)
Pooled Mean		26.12	29.74	35.42	38.57
Total S.D.		13.38	12.31	11.35	11.40
Total N		(521)	(499)	(357)	(283)
V_1		0.19^{a}	0.25^{b}	0.21^{b}	0.29^{b}
$V_1/SE(V_1)$		1.78	2.28	1.60	2.02
V_2		—0.68	—0.37	—0.06	—0.06

a-Positive Skewness

b-Negative Skewness

*Significantly different from Normal Distribution at 1% level of significance.

TABLE 3

REASONING ABILITY

Agewise Mean Scores, Standard Deviations V_1, $V_1/S.E.V_1$, V_2 and Number of Students Reading in Classes VIII, IX, X, and XI.

Age	*Class*	*VIII*	*IX*	*X*	*XI*
12+	Mean	38.25			
	S.D.	6.40			
	N	(88)			
13+	Mean	36.45	38.04		
	S.D.	7.62	5.17		
	N	(199)	(69)		
14+	Mean	39.11	36.95	40.05	
	S.D.	6.53	7.22	4.54	
	N	(123)	(190)	(59)	
15+	Mean	32.78	36.18	38.90	40.10
	S.D.	6.87	7.32	5.52	5.82
	N	(96)	(199)	(108)	(31)
16+	Mean	27.40	34.66	37.94	40.59
	S.D.	6.77	6.89	6.43	4.34
	N	(15)	(77)	(102)	(96)
17+	Mean		33.18	38.40	39.72
	S.D.		6.47	6.77	6.18
	N		(44)	(58)	(75)
18+	Mean			35.10	37.51
	S.D.			6.82	7.44
	N			(30)	(53)
19+	Mean				37.86
	S.D.				6.84
	N				(28)
Pooled Mean		36.44	35.99	38.41	39.46
Total S.D.		7.49	7.61	6.10	6.04
Total N		(521)	(499)	(357)	(283
V_1		0.31[b]	1.01[b]	1.68[b]	1.78*
$V_1/S.E.V_1$		2.89*	9.24*	13.02*	12.29
V_2		0.10	1.75	6.58	5.33

a-Positive Skewness

b-Negative Skewness

*Significantly different from Normal Distribution at 1% level of significance.

TABLE 4

NUMERICAL ABILITY

Agewise Mean Scores, Standard Deviation V_1, $V_1/S.E.V_1$, V_2 and Numbers of Students Reading in Classes VIII, IX, X and XI.

Age	Class	VIII	IX	X	XI
12+	Mean	10.44			
	S.D.	5.69			
	N	(88)			
13+	Mean	8.77	11.91		
	S.D.	5.72	6.98		
	N	(199)	(69)		
14+	Mean	6.78	10.38	14.27	
	S.D.	4.97	7.14	7.33	
	N	(123)	(190)	(59)	
15+	Mean	5.56	9.30	12.53	17.65
	S.D.	3.94	5.75	7.94	6.83
	N	(96)	(119)	(108)	(31)
16+	Mean	4.20	7.16	11.26	17.75
	S.D.	3.78	5.03	7.82	8.35
	N	(15)	(77)	(102)	(96)
17+	Mean		5.84	9.12	15.52
	S.D.		4.53	6.21	9.02
	N		(44)	(58)	(75)
18+	Mean			5.20	13.62
	S.D.			4.28	8.45
	N			(30)	(53)
19+	Mean				10.64
	S.D.				7.32
	N				(28)
Pooled Mean		7.85	9.46	11.28	15.67
Total S.D.		5.48	6.54	7.68	8.60
Total N		(521)	(499)	(357)	(283)
V_1		0.87[a]	0.74[a]	0.46[a]	0.09[a]
$V_1/S.E.V_1$		8.14*	6.72*	3.58*	0.64
V_2		0.34	1.20	0.61	0.83

a-Positive Skewness
b-Negative Skewness
*Significantly different from Normal Distribution at 1%.

TABLE 5

SPATIAL ABILITY

Agewise Mean Scores, Standard Deviations V_1, $V_1/S.E.V_1$, V_2 and Number of Students Reading in Classes VIII, IX, X and XI.

Age	*Class*	*VIII*	*IX*	*X*	*XI*
12+	Mean	23.70			
	S.D.	11.06			
	N	(88)			
13+	Mean	24.34	25.33		
	S.D.	12.83	11.72		
	N	(190)	(60)		
14+	Mean	21.11	23.16	29.88	
	S.D.	11.31	12.12	12.01	
	N	(123)	(190)	(59)	
15+	Mean	18.56	21.92	28.62	30.08
	S.D.	10.06	11.65	13.19	15.76
	N	(96)	(119)	(108)	(31)
16+	Mean	19.67	18.36	26.80	32.47
	S.D.	11.53	12.58	13.61	12.79
	N	(15)	(77)	(102)	(96)
17+	Mean		21.32	23.12	30.93
	S.D.		9.02	12.11	11.95
	N		(44)	(58)	(75)
18+	Mean			21.17	26.53
	S.D.			13.35	12.83
	N			(30)	(53)
19+	Mean				24.14
	S.D.				13.35
	N				(28)
Pooled Mean		22.27	22.26	26.79	29.93
Total S.D.		11.88	11.96	13.26	23.32
Total N		(521)	(490)	(357)	(289)
	V_1	0.22[a]	0.18[a]	0.01[b]	0.17[a]
	$V_1/S.E.V_1$	2.04	1.66	0.77	1.16
	V_2	0.61	0.67	—0.71	0.66

a-Positive Skewness
b-Negative Skewness
*Significantly different from Normal Distribution at 1% level of significance.

INDIAN EDUCATIONAL REVIEW
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TABLE 6

CLERICAL ABILITY

Agewise Mean Scores, Standard Deviations V_1, $V_1/S.E.V_1$, V_2 and Number of Students Reading in Classes VIII, IX, X and XI.

Age	*Class*	*VIII*	*IX*	*X*	*XI*
12+	Mean	42.45			
	S.D.	12.45			
	N	(88)			
13+	Mean	41.00	47.58		
	S.D.	14.16	16.01		
	N	(199)	(60)		
14+	Mean	37.33	46.08	52.42	
	S.D.	10.30	16.53	17.28	
	N	(123)	(190)	(59)	
15+	Mean	35.28	45.28	50.66	57.48
	S.D.	13.78	16.51	16.99	15.46
	N	(96)	(119)	(108)	(31)
16+	Mean	36.67	42.84	52.34	53.77
	S.D.	12.24	16.01	15.18	19.47
	N	(15)	(77)	(102)	(96)
17+	Mean		41.77	49.67	54.20
	S.D.		13.18	15.59	18.17
	N		(44)	(58)	(75)
18+	Mean			42.37	52.34
	S.D.			13.04	18.86
	N			(30)	(53)
19+	Mean				50.04
	S.D.				10.88
	N				(23)
Pooled Mean		39.20	45.22	50.47	52.65
Total S.D.		13.18	16.18	16.27	18.27
Total N		(521)	(499)	(357)	(283)
V_1		0.05^b	0.27^b	0.39^b	0.64^b
$V_1/S.E.V_1$.		0.44	2.44	2.98†	4.44†
V_2		0.32		1.37	1.12

a-Positive Skewness
b-Negative Skewness
†Significantly different from Normal Distribution at 1% level of significance.

TABLE 7

MECHANICAL ABILITY

Agewise Mean Scores, Standard Deviations V_1, $V_1/S.E.V_1$, V_2 and Numbers of Students Reading in Classes VIII, IX, X & XI.

Age	*Class*	*VIII*	*IX*	*X*	
12+	Mean	65.92			
	S.D.	9.87			
	N	(88)			
13+	Mean	65.34	50.04		
	S.D.	9.20	11.76		
	N	(199)	(69)		
14+	Mean	61.11	48.97	57.68	
	S.D.	9.44	12.01	11.94	
	N	(123)	(190)	(59)	
15+	Mean	63.41	46.87	55.24	59.00
	S.D.	8.45	10.66	11.13	12.89
	N	(96)	(119)	(108)	(31)
16+	Mean	59.00	44.86	51.51	58.77
	S.D.	8.33	9.88	12.06	1295)
	N	(15)	(77)	(102)	(96
17+	Mean		46.43	48.12	54.47
	S.D.		11.88	11.04	12.62
	N		(44)	(58)	(75)
18+	Mean			42.83	50.96
	S.D.			9.84	13.56
	N			(30)	(53)
19+	Mean				50.39
	S.D.				11.58
	N				(82)
Pooled Mean		63.90	47.70	52.38	55.08
Total S.D.		9.43	11.47	12.17	13.21
Total N		(521)	(490)	(357)	(285)
V_1		0.28[a]	0.46[a]	0.07[a]	0.10[a]
$V_1/S.E.V._1$		2.65†	4.24†	0.50	0.70
V_2		0.42	1.94	—0.03	—0.44

a-Positive Skewness

b-Negative Skewness

†Significantly different from Normal Distribution at 1% level of significance.

holds good for all the classes as also for all the abilities included in the study. It appeared, therefore, that younger children were brighter than the older ones within a class.

To determine whether age really exerted any differential effect on the ability scores of the students within a class, analysis of variance test was used.

The analysis of variance for *verbal ability* scores is given in Table 8.

TABLE 8

Analysis of Variance for Verbal Ability Scores

Class	*Age Range*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
VIII	12—16	Between Ages	4	11812.09	2953.02	18.95†
		Within Ages	516	81233.71	157.43	
IX	13—17	Between Ages	4	3596.81	899.20	5.42†
		Within Ages	494	81894.85	165.78	
X	14—18	Between Ages	4	3620.71	905.18	7.54†
		Within Ages	352	42259.63	120.06	
XI	15—19	Between Ages	4	196.60	49.15	0.37
		Within Ages	278	36453.63	131.13	

†Significant at 5% level of significance.

From the above table it is observed that the F ratio goes on decreasing in magnitude from class VIII to class XI. It is significant for class VIII, IX and X but not significant for class XI, and is, therefore, indicative of decreasing influence of age on the verbal scores of the students. There are no significant differences in the mean verbal scores of the students of different age groups at class XI whereas there are significant differences in the mean verbal scores of the students of different age groups at the VIII, IX and X grades.

The analysis of variance for *reasoning ability* scores is presented in Table 9.

Although the F ratio goes on decreasing from eighth grade to eleventh grade and is indicative of the decreasing influence of age on reasoning ability scores but it (F ratio) is significant at all grades. There are significant differences in the mean scores of

TABLE 9

Analysis of Variance for Reasoning Ability Scores

Class	*Age Range*	*Components*	*d f.*	*Sum of Squares*	*Variance*	*F*
VIII	12—16	Between Ages	4	3676.04	919.01	18.63†
		Within Ages	516	25456.98	49.34	
IX	13—17	Between Ages	4	1025.91	256.48	4.56†
		Within Ages	494	27813.07	56.30	
X	14—18	Between Ages	4	535.68	133.92	3.71†
		Within Ages	352	12702.96	36.09	
XI	15—19	Between Ages	4	414.65	103.66	2.92†
		Within Ages	278	9870.03	35.54	

†Significant at 5% level of significance.

pupils of different age groups in each of the classes eighth through eleventh. Thus no class is homogenous in terms of brightness and pupils of different degrees of brightness in reasoning ability exist in each class.

The analysis of variance for *numerical ability* scores is given in Table 10.

TABLE 10

Analysis of Variance for Numerical Ability Scores

Class	*Age Range*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
VIII	12—16	Between Ages	4	1616.23	404.06	20.96†
		Within Ages	516	14009.05	19.28	
IX	13—17	Between Ages	4	1561.62	390.40	9.76†
		Within Ages	494	19757.93	40.00	
X	14—18	Between Ages	4	2112.27	528.07	9.83†
		Within Ages	352	18905.23	53.71	
XI	15—19	Between Ages	4	1467.74	366.94	5.26†
		Within Ages	278	19408.54	69.81	

†Significant at 5% level.

The observations and comments made on Table 9 apply to Table 10 as well.

The analysis of variance of *spatial ability* scores is given in Table 11.

TABLE 11

Analysis of Variance for Spatial Ability Scores

Class	*Age Range*	*Comments*	*d.f.*	*Sum of Squares*	*Variance*	*F*
VIII	12–16	Between Ages	4	2617.81	654.45	4.77*
		Within Ages	516	70735.84	137.09	
IX	13–17	Between Ages	4	2026.55	506.64	3.61*
		Within Ages	494	69236.87	140.16	
X	14–18	Between Ages	4	2655.25	663.81	3.90*
		Within Ages	352	59900.30	170.10	
XI	15–19	Between Ages	4	2263.65	565.91	3.29*
		Within Ages	278	47801.66	171.95	

*Significanct at 5% level of significance.

The observations and comments made about reasoning ability scores apply equally to spatial ability scores.

The analysis of variance for *clerical ability* scores is given in Table 12.

TABLE 12

Analysis of Variance for Clerical Ability Scores

Class	*Age Range*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
VIII	12–16	Between Ages	4	3573.82	893.46	5.31*
		Within Ages	516	86732.82	168.09	
IX	13–17	Between Ages	4	1483.12	370.78	1.42
		Within Ages	494	128873.31	260.88	
X	14–18	Between Ages	4	3219.12	804.78	3.11*
		Within Ages	352	90974.12	258.45	
XI	15–19	Between Ages	4	2908.40	727.10	2.24
		Within Ages	278	90148.44	324.27	

*Significant at 5% level of significance.

The F ratio is significant at all grades except IX and XI, therefore, there are significant differences in the mean scores of pupils of different ages except 13 to 17 and 15 to 19.

The analysis of variance for mechanical ability scores is given in Table 13.

TABLE 13

Analysis of Variance for Mechanical Ability Scores

Class	*Age Range*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
VIII	12–16	Between Ages	4	2113.86	528.46	6.18*
		Within Ages	516	44102.50	85.47	
IX	13–17	Between Ages	4	1460.63	365.16	2.82*
		Within Ages	494	64049.47	129.65	
X	14–18	Between Ages	4	6403.49	1600.87	15.14*
		Within Ages	352	40321.69	103.19	
IX	15–19	Between Ages	4	2899.75	724.94	4.35*
		Within Ages	278	46343.26	166.70	

*Significant at 5% level of significance.

The F ratio is significant at all the grades and, therefore, there are significant differences in the mean scores of pupils of different ages.

Class Variations

If we go through the Tables 2 to 7 we see that pupils of ages 15+ & 16+ appear in all the classes and the mean scores of pupils of the same age group go on increasing. This variation in scores appeared to be due to the effect of added instruction.

To find out whether class really exerted any differential effect on the ability scores of the students belonging to the same age groups, analysis of variance test was used.

The analysis of variance for *verbal ability* scores is given in Table 14.

From the above Table it is observed that the F ratio is significant for both the ages. There are significant differences in the mean verbal scores of 15+ children in different classes as also of children

TABLE 14

Analysis of Variance for Verbal Ability Scores

Age	*Classes*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
15+	VIII, IX, X & XI	Between Classes	3	17943.38	5981.13	40.88*
		Within Classes	350	51214.60	146.33	
16+	VIII, IX X & XI	Between Classes	3	8709.11	2903.04	26.67*
		Within Classes	286	31132.80	108.86	

*Significant at 5% level of significance.

of 16+. However, the value of the F ratio decreases from age 15+ to age 16+ and therefore school curriculum did not increase differences.

Analysis of a variance for *reasoning ability* scores is given in Table 15.

TABLE 15

Analysis of Variance for Reasoning Ability Scores

Age	*Classes*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
15+	VIII, IX, X & XI	Between Classes	3	2501.99	834.00	19.40*
		Within Classes	350	15002.73	42.86	
16+	VIII, IX, X & XI	Between Classes	3	3086.09	1038.70	28.67*
		Within Classes	286	10261.87	35.88	

*Significant at 5% level of significance.

In Table 15, F ratio is significant for both the age groups which indicates that there are differences in reasoning ability scores of children of the same age due to grade. Further the F ratio is larger for 16+ and the curriculum seems to widen the differences in reasoning ability scores at higher age level.

Analysis of variance of *numerical ability* scores is given in Table 16.

In Table 16, the F ratio is significant for both the age groups and is indicative of the differences in numerical ability scores of

TABLE 16

Analysis of Variance for Numerical Ability Scores

Age	Classes	Components	d.f.	Sum of Squares	Variance	F
15+	VIII, IX, X & XI	Between Classes	3	4436.30	1478.77	38.26
		Within Classes	350	13529.39	38.06	
16+	VIII, IX, X & XI	Between Classes	3	5948.72	1982.91	38.09
		Within Classes	286	14889.30	52.06	

*Significant at 5% level of significance.

children of different classes. But the value of the F ratio being same, the curriculum does not widen, increase or decrease, these differences.

Analysis of variance for *spatial ability* scores is given in Table 17.

TABLE 17

Analysis of Variances for Spatial Ability Scores

Age	Classes	Components	d.f.	Sum of Squares	Variance	F
15+	VIII, IX, X & XI	Between Classes	3	19601.97	6533.99	44.24*
		Within Classes	350	51696.90	147.71	
16+	VIII, IX, X & XI	Between Classes	3	9173.00	3057.67	18.11*
		Within Classes	286	48284.49	168.83	

*Significant at 5% level of significance

Observations and comments made on Table 14 also apply to Table 17.

Analysis of variance for *clerical ability* scores is given in Table 18.

TABLE 18

Analysis of Variance for Clerical Ability Scores

Age	Classes	Components	d.f.	Sum of Squares	Variance	F
15+	VIII, IX, X & XI	Between Classes	3	17337.47	5779.16	22.85*
		Within Classes	350	88519.06	252.91	
16+	VIII, IX, X & XI	Between Classes	3	8455.09	2818.36	9.92*
		Within Classes	286	81252.71	284.10	

*Significant at 5% level of significance.

Observations and comments made on Table 14 apply to Table 18 as well.

Analysis of variance for *mechanical ability* scores is given in Table 19.

TABLE 19

Analysis of Variance for Mechanical Ability Scores

Age	*Classes*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
15+	VIII, IX, X & XI	Between Classes	3	15151.70	5050.57	46.00*
		Within Classes	350	38424.84	109.79	
16+	VIII, IX, X & XI.	Between Classes	3	9006.25	3002.08	21.97*
		Within Classes	286	39072.22	136.62	

*Significant at 5% level of significance.

Observations and comments made on Table 14 also apply to Table 19.

Class-Cum-Age Variation

If we go through Tables 2, 3, 4, 5, 6, and 7 and read along the diagonals, the mean ability scores of pupils (whose ages and grade increase by one step) are found to vary within themselves. This is on account of the age-cum-class effect on the ability scores. To observe whether age and class both really exerted and differential effect on the ability scores of the students, the technique of analysis of variance was used.

Analysis of variance for *verbal ability* scores is given in Table 20.

It is observed from Table 20 that F ratio is significant for all the groups. Thus age and education both affect verbal ability scores. Further the effect appears to be increasing from the first to the fourth groups but it is much less in the case of the fifth group.

Analysis of variance for *reasoning ability* scores is given in Table 21.

It is observed from Table 21 that F ratio is significant for all

TABLE 20

Analysis of Variance for Mean Verbal Ability Scores

Group No.	*Class cum Age*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
I	VIII/12+ IX/13+	Between Class-Cum Ages	3	2327.44	775.81	4.92*
	X/14+ XI/15+	Within-Classes-Cum-Ages	243	38291.47	157.58	
II	VIII/13+ IX/14+	Between-Class-Cum-Ages	3	9929.92	3309.97	19.85*
	X/15+ XI/16+	Within-Classes-Cum-Ages	589	98239.25	166.79	
III	VIII/14+ IX/15+	Between-Class-Cum-Ages	3	15855.11	5285.04	37.08*
	X/16+ XI/17+	Within-Classes-Cum-Ages	415	57744.90	130.14	
IV	VIII/15+ IX/16+	Between-Class-Cum-Ages	3	43182.97	14394.32	111.12*
	X/17+ XI/18+	Within-Classes-Cum-Ages	280	36269.46	129.53	
V	VIII/16+ IX/17+	Between-Class-Cum-Ages	3	5039.10	1679.70	17.87*
	X/18+ XI/19+	Within-Classes-Cum-Ages	113	10622.64	94.01	

*Significant at 5% level of significance.

the groups except first. Thus age and education both affect reasoning ability scores of pupils of second, third, fourth and fifth groups. Further this effect appears to be the same for these groups.

Analysis of variance for *numerical ability* scores is given in Table 22.

It is observed from Table 22 that F-ratio is significant for all the groups except fourth. Thus age and education both affect numerical ability scores of pupils of first, second, third and fifth groups.

Analysis of variance for *spatial ability* scores is given in Table 23.

It is observed from Table 23 that F-ratio is significant for all the groups except fifth. Thus age and education both affect

TABLE 21

Analysis of Variance for Mean Reasoning Ability Scores

Group No.	Class Cum Age	Components	d.f.	Sum of Squares	Variance	F
I	VIII/12+ IX/13+	Between-Class-Cum-Age	3	209.82	69.94	2.23
	X/14+ XI/15+	Within-Classes-Cum-Ages	243	7624.69	31.38	
II	VIII/13+ IX/14+	Between-Class-Cum-Age	3	1376.50	459.50	10.20*
	X/15+ XI/16+	Within-Classes-Cum-Ages	589	26534.28	45.05	
III	VIII/14+ IX/15+	Between-Class-Cum-Age	3	1306.32	435.44	9.67*
	X/16+ IX/17	Within-Classes-Cum-Ages	415	18695.74	45.05	
IV	VIII/15+ IX/16+	Between-Class-Cum-Age	3	1455.07	485.02	10.02*
	X/17+ XI/18+	Within-Classes-Cum-Ages	280	13516.29	48.27	
V	VIII/16+ IX/17+	Between-Class-Cum-Age	3	1135.41	378.41	8.17*
	X/18+ XI/19+	Within-Classes-Cum Ages	113	5236.06	46.34	

*Significant at 5% level of significance.

spatial ability scores of the pupils of first, second, third, and fourth groups. Further this effect appears to be decreasing from second to fifth group.

Analysis of variance for mean *clerical ability* scores is given in Table 24.

It is observed from Table 24 that F-ratio is significant for all the groups. Thus age and education both affect clerical ability scores. Further this effect appears to increase from first to third group and decrease thereafter from third to fifth group.

Analysis of variance for *mechanical ability* scores is given in Table 25.

It is observed from Table 25 that F-ratio is significant for all

TABLE 22

Analysis of Variance for Mean Numerical Ability Scores

Group No.	*Class Cum Age*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
I	VIII/12+ IX/13+	Between-Class-Cum-Age	3	1394.49	464.83	10.50*
	X/14+ XI/15+	Within-Classes-Cum Ages	243	10694	44.01	
II	VIII/13+ IX/14+	Between-Class-Cum-Age	3	5583.83	1861.28	42.80*
	X/15+ XI/16+	Within-Classes-Cum-Ages	589	25616.72	43.49	
III	VIII/14+ IX/15+	Between-Class-Cum-Age	3	3706.83	1265.61	27.18*
	X/16+ XI/17+	Within-Classes-Cum-Ages	415	19321.88	46.56	
IV	VIII/15+ IX/16+	Between-Class-Cum-Age	3	2359.19	78.64	2.36
	X/17+ XI/18+	Within-Classes-Cum-Ages	280	9336.71	33.35	
V	VIII/16+ IX/17+	Between-Class-Cum-Age	3	636.96	212.32	7.68*
	X/18+ XI/19+	Within-Classes-Cum-Ages	113	3123.36	27.64	

*Significant at 5% level of significance.

the groups. Thus age and education both affect mechanical ability scores.

Thus the data permitted us to compare development and differentiation of abilities for different brightness groups which are as under:

(i) *First Level of Brightness*—12 year old pupils of class eight; 13 year old pupils of class ninth; 14 year old pupils of class tenth and 15 year old pupils of class eleventh.

(ii) *Second Level of Brightness*—13 year old pupils of class eight; 14 year old pupils of class ninth; 15 year old pupils of class tenth and 16 year old pupils of class eleventh.

(iii) *Third Level of Brightness*—14 year old pupils of class

TABLE 23

Analysis of Variance for Mean Spatial Ability Scores

Group No.	Class Cum Age	Components	d.f.	Sum of Squares	Variance	F
I	VIII/12+ IX/13+	Between-Class-Cum-Age	3	2005.54	668.51	4.51*
	X/14+ XI/15+	Within-Classes-Cum-Ages	243	36033.70	148.29	
II	VIII/13+ IX/14+	Between-Class-Cum-Age	3	6842.18	2280.73	14.08*
	X/15+ XI/16+	Within-Classes-Cum-Ages	589	95380.07	161.95	
III	VIII/14+ IX/15+	Between-Class-Cum-Age	3	5845.97	1948.66	13.15*
	X/16+ XI/17+	Within-Classes-Cum-Ages	415	61506.90	148.21	
IV	VIII/15+ IX/16+	Between-Class-Cum-Age	3	2984.66	994.89	7.22*
	X/17+ XI/18+	Within-Classes-Cum-Ages	280	38562.83	137.72	
V	VIII/16+ IX/17+	Between-Class-Cum-Age	3	243.77	81.26	0.56
	X/18+ XI/19+	Within-Classes-Cum-Ages	113	16298.02	144.23	

*Significant at 5% level of significance.

eight; 15 year old pupils of class ninth; 16 year old pupils of class tenth and 17 year old pupils of class eleventh.

(iv) *Fourth Level of Brightness*—15 year old pupils of class eight; 16 year old pupils of class ninth; 17 year old pupils of class tenth and 18 year old pupils of class eleventh.

(v) *Fifth Level of Brightness*—16 year old pupils of class eight; 17 year old pupils of class ninth; 18 year old pupils of class tenth and 19 year old pupils of class eleventh.

IV. Growth of Abilities

Age progress curves indicate the general course of development of different abilities under given cultural conditions and serve a use-

TABLE 24

Analysis of Variance for Clerical Ability Scores

Group No.	*Class Cum Age*	*Components*	*d.f.*	*Sum of Squares*	*Variance*	*F*
I	VIII/12+ IX/13+	Between-Class-Cum-Age	3	6655.42	2218.47	9.69*
	X/14+ XI/15+	Within-Classes-Cum Ages	243	55629.66	228.93	
II	VIII/13+ IX/14+	Between-Class-Cum-Age	3	13004.69	4334.90	16.02*
	X/15+ XI/16+	Within-Classes-Cum-Ages	589	159417.71	270.66	
III	VIII/14+ IX/15+	Between-Class-Cum-Age	3	18421.75	6140.58	27.19*
	X/16+ XI/17+	Within-Classes-Cum Ages	415	93730.98	225.86	
IV	VIII/15+ IX/16+	Between-Class-Cum-Age	3	9068.11	3022.70	12.11*
	X/17+ XI/18+	Within-Classes-Cum-Ages	280	69871.33	249.54	
V	VIII/16+ IX/17+	Between-Class-Cum-Age	3	2154.65	718.22	4.43*
	X/18+ XI/19	Within-Classes-Cum-Ages	113	18316.70	162.09	

*Significant at 5% level of significance.

ful purpose as descriptive devices. The progress during first, second and the third year was estimated by measuring the angles made by growth curve with the horizontal during these years as also by the differences between mean scores of consecutive classes. The growth angles and the rates of growth for the six abilities have been shown in Appendix IV:

Verbal Ability

The mean verbal scores for the five levels of brightness were plotted and the growth curves for each level were drawn which are shown in Figure 2(a).

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 1, January 1973

FIGURE 2 (a)
Curves for Mean Verbal Scores

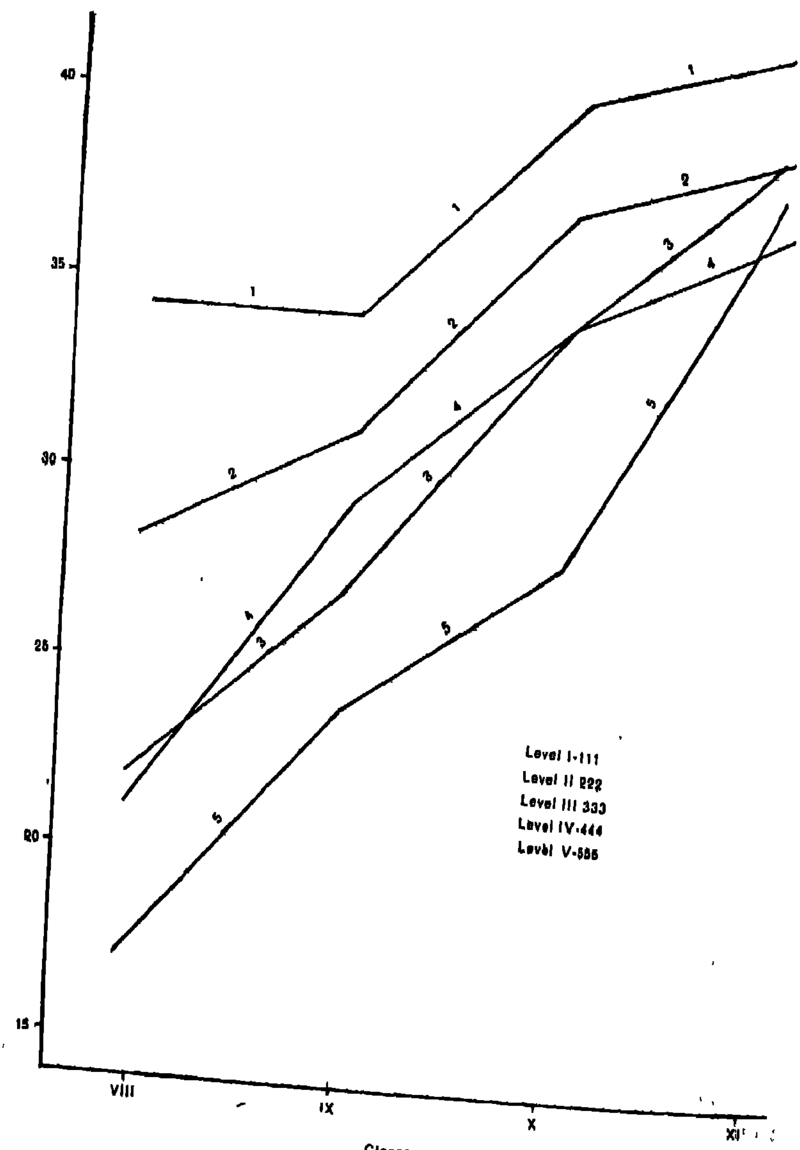


TABLE 25

Analysis of Variance for Mean Mechanical Ability Scores

Group No.	Class Cum Age	Components	d.f.	Sum of Squares	Variance	F
I	VIII/12+ IX/13+	Between-Class-Cum-Age	3	9954.12	3318.04	25.76*
	X/14+ XI/15+	Within-Classes-Cum-Ages	243	31310.49	128.85	
II	VIII/13+ IX/14+	Between-Class-Cum-Age	3	26700.29	8900.10	71.13*
	X/15+ XI/16+	Within-Classes-Cum-Ages	589	73702.48	125.13	
III	VIII/14+ IX/15+	Between-Class-Cum-Ages	3	12827.89	4275.96	34.63*
	X/16+ XI/17+	Within-Classes-Cum-Ages	415	51236.99	123.46	
IV	VIII/15+ IX/16+	Between-Class-Cum-Age	3	17101.21	5700.40	51.94*
	X/17+ XI/18+	Within-Classes-Cum-Ages	280	30727.41	109.74	
V	VIII/16+ IX/17+	Between-Class-Cum-Age	3	2884.09	961.36	7.81*
	X/18+ XI/19+	Within-Classes-Cum-Ages	113	13908.15	123.08	

*Significant at 5% level of significance.

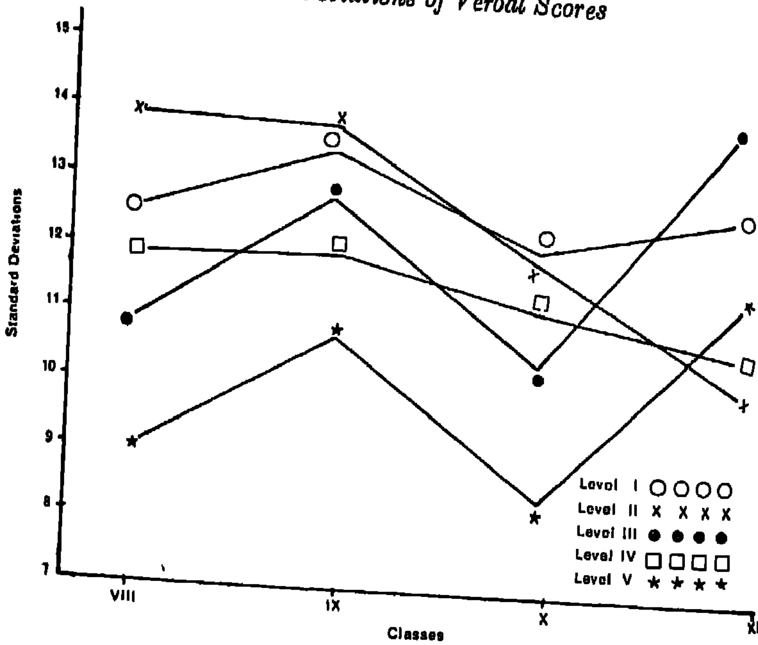
From figure 2(a) it appears that the brighter groups begin at a higher level but grow at a slower rate than the duller groups so that the difference between the groups of varying brightness tends to decrease. Freeman and Flory (1937) had obtained similar results while studying the general intellectual growth of youth of varying degrees of over-all brightness.

The curves for standard deviations for the five levels of brightness are shown in figure 2(b).

From Figure 2(b) it appears that the standard deviations do not increase but remain almost the same for any level of brightness. Also there are not much variations between the standard deviations of group of differing brightness.

FIGURE 2 (b)

Standard Deviations of Verbal Scores



The significance of difference between means of consecutive pairs of groups for each level of brightness was tested by determining the Critical Ratio and interpreting the latter with the help of normal distribution in case of large samples (N$\geqslant$30) and with the help of t—distribution in case of small samples (N<30).

For the brightest group, there was significant growth of verbal ability from class IX to class X only, it did not show any significant change from class VIII to class IX and from class X to class XI.

For the second level of brightness, there was significant growth of verbal ability from class VIII to class IX as also from class IX to class X, but there was no significant change in it from class X to class XI.

For the third level of brightness, the growth of verbal ability was significant throughout from one class to another.

For the fourth level of brightness, there was significant growth

TABLE 26

Significance of Difference Between Means of Verbal Scores of Consecutive Groups.

Brightness Level	Group I				Group II				Dm	C.R.
	Class/Age	M	S.D.	N	Class/Age	M	S.D.	N		
I	VIII/.2+	33.65	12.47	88	IX/13+	33.52	13.32	69	.13	.06
	IX/13+	33.52	13.32	69	X/14+	40.47	11.75	59	6.95	3.13††
	X/14+	40.47	11.75	59	XI/15+	42.18	12.28	31	1.70	1.02
II	VIII/13+	28.43	13.89	199	IX/14+	31.32	13.67	190	2.88	2.06*
	IX/14+	31.32	13.67	190	X/15+	36.68	11.85	108	5.36	3.55††
	X/15+	36.68	11.85	108	XI/16+	39.34	9.76	96	2.67	1 76
III	VIII/14+	22.08	10.89	123	IX/15+	27.42	12.58	119	5.34	3.53††
	IX/15+	27.42	12.58	119	X/16+	33.91	10.07	102	6.49	4.26††
	X/16+	33.91	10.07	102	IX/17+	38.87	13.65	75	4.96	2.66††
IV	VIII/15+	21.01	11.89	96	IX/16+	29.34	11.80	77	8.33	4.60††
	IX/16+	29.34	11.80	77	X/17+	34.41	10.89	58	5.08	2.59††
	X/17+	34.41	10.89	58	XI/18+	37.19	10.28	53	2.77	1.38
V	VIII/16+	17.00	9.13	15	IX/17+	23.93	10.56	44	6.93	3.29††
	IX/17+	23.93	10.56	44	X/18+	28.00	8.10	30	4.07	1.87
	X/18+	28.00	8.10	30	XI/19+	37.54	10.88	28	9.54	3.76††

*Significant at 5% level.
††Significant at 1% level.

from class VIII to class IX and from class IX to class X but there was no significant change thereafter, that is, from class X to class XI.

For the dullest group, there was significant growth from class VIII to class IX and from class X to class XI but no significant change in the intervening period from class IX to class X.

It, therefore, became evident that the rates of growth for different levels of brightness were different, the brighter had grown faster in the early years during junior high school and the duller in the later years of higher secondary school. It is difficult to infer from the data that the verbal ability had stabilised during higher secondary school stage. The standing of a pupil in his group changed as he proceeded from class VIII to class XI.

Spatial Ability

The mean spatial scores for the five levels of brightness were plotted and the growth curves for each level were drawn which are shown in Figure 3(a).

From Figure 3(a) it was noticed that the rate of growth of spatial ability for middle levels of brightness is almost similar, it is continuous and is high. For the brightest group the rate of growth in the last phase, from class X to class XI, is rather slow. For the dullest group there is almost no growth during the second year, and although the rate of growth is quite high in the third year it is less than those for middle levels of brightness. The difference in the spatial scores of the groups of different levels of brightness, therefore, have increased at the eleventh class in comparison to the differences at the eighth grade.

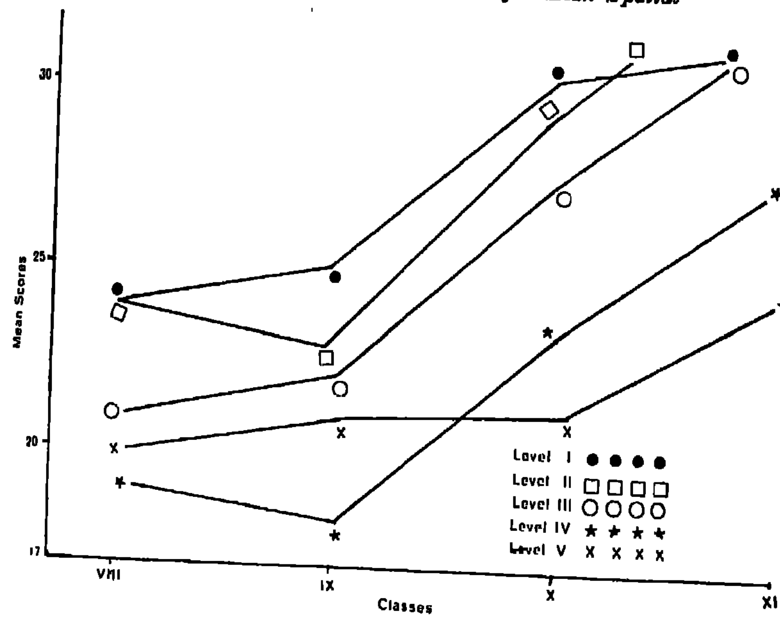
The standard deviation curves for the five levels of brightness have been presented in Figure 3(b).

From Figure 3(b) it appears standard deviations did not increase (except in the case of C XI|15+ where N=15 only) but remained almost of the same magnitude for every level of brightness. Also there was not much variation between the standard deviations of groups of differing brightness.

The significance of difference between means of consecutive pairs of groups for each level of brightness was tested; the results are set out in Table 27.

FIGURE 3 (a)

Curves for Mean Spatial Scores Curves for Mean Spatial



For the brightest group, the growth of spatial ability was similar to the growth of verbal ability, it being significant from class IX to class X but not significant from class VIII to class IX and from class X to class XI.

For the second level of brightness, there was no growth from class VIII to class IX but thereafter there was continuous growth from class IX to class X and from class X to class XI.

The growth for the third level of brightness was similar to that of the second level of brightness; it was significant during classes X and XI.

The growth for the fourth level of brightness was similar to that of the first level of brightness, being significant from class IX to class X only.

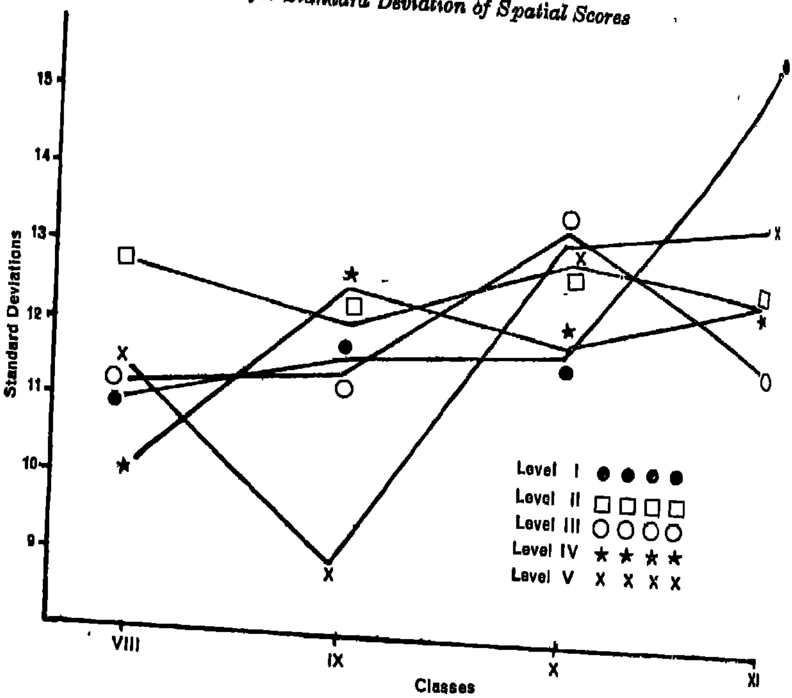
For the dullest group there was no growth practically as none of the differences were significant.

Thus it appeared that the growth characteristics of spatial abi-

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 1, January 1973

FIGURE 3 (b)

Curves for Standard Deviation of Spatial Scores



lity for different levels of brightness were different, the differences between the first three levels of brightness tended to decrease as the age increased but the same was not true of the duller groups. Specially for the dullest group, stability seems to have been reached at the eighth grade level.

Clerical Ability

The mean clerical scores for the five levels of brightness were plotted and the growth curves for each level were drawn which are shown in Figure 4(a).

From Figure 4(a) it is noticed that the rate of growth of clerical ability was high during the first year for all the levels of brightness. During the second year the rate of growth was again

TABLE 27

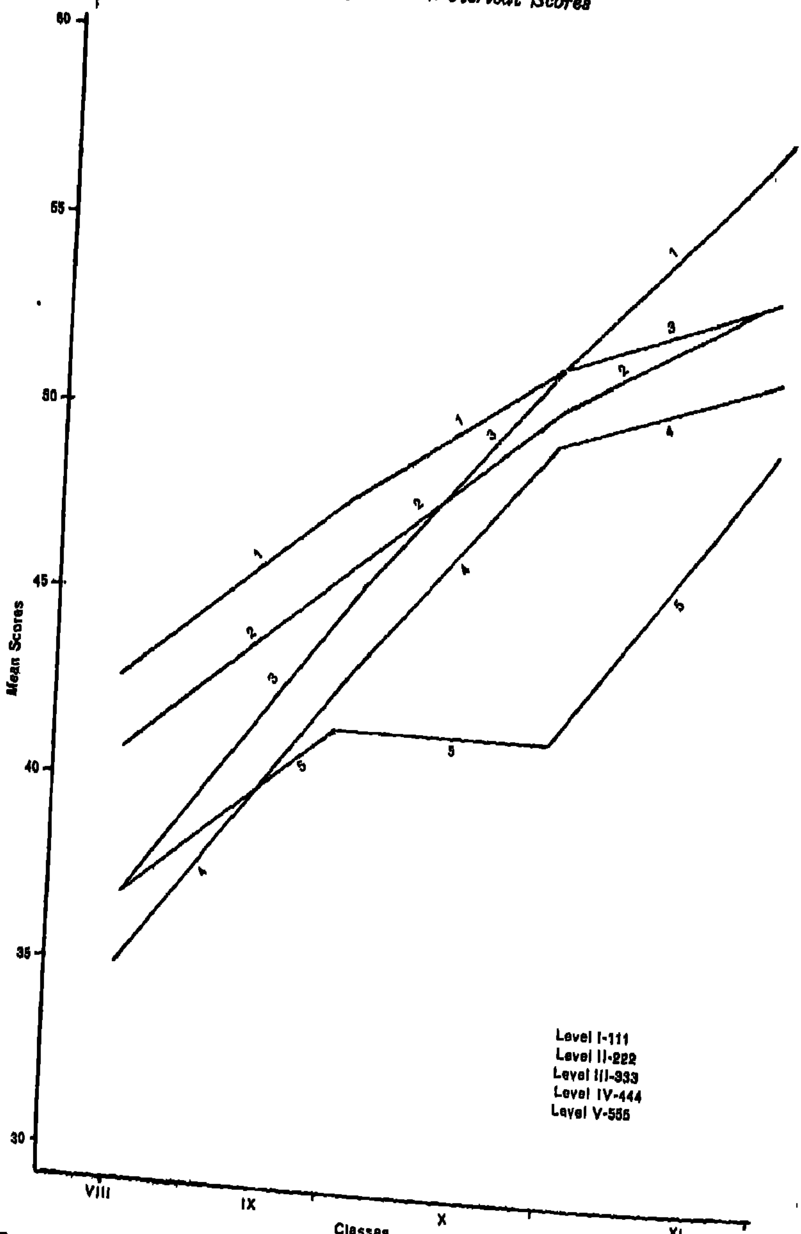
Significance of Difference Between Mean Spatial Ability Scores of Consecutive Groups

Brightness Level	Group I				Group II				D_M	C.R.
	Class/Age	M	S.D.	N	Class/Age	M	S.D.	N		
I	VIII/12+	23.70	11.06	88	IX/13+	25.33	11.72	69	1.63	0.89
	IX/13+	25.33	11.72	69	X/14+	29.88	12.00	59	4.55	2.16*
	X/14+	29.88	12.00	59	XI/15+	30.08	15.76	31	0.83	0.26
II	VIII/13+	24.34	12.83	199	IX/14+	23.16	12.17	190	1.18	0.03
	IX/14+	23.16	12.17	190	X/15+	28.62	13.19	108	5.46	3.53††
	X/15+	28.62	13.19	108	XI/16+	32.47	12.79	96	3.85	2.11*
III	VIII/14+	12.11	11.31	123	IX/15+	21.92	11.65	119	.81	.55
	IX/15+	21.92	11.65	119	X/16+	26.80	13.61	102	4.88	2.84††
	X/16+	26.80	13.61	102	XI/17+	30.93	11.65	75	4.13	2.14*
IV	VIII/15+	18.56	10.06	96	IX/16+	18.36	12.58	77	0.20	0.11
	IX/16+	18.36	12.58	77	X/17+	23.12	12.10	58	4.76	2.22*
	X/17+	23.12	12.10	58	XI/18+	26.53	12.83	53	3.41	1.44
V	VIII/16+	19.67	11.53	15	IX/17+	21.32	9.02	44	1.65	0.51
	IX/17+	21.32	9.02	44	X/18+	21.17	13.35	30	0.15	0.05
	X/18+	21.17	13.35	30	XI/19+	24.14	13.85	28	2.98	0.83

††Significant at 1%.
*Significant at 5%

FIGURE 4 (a)

Curves for Mean Clerical Scores

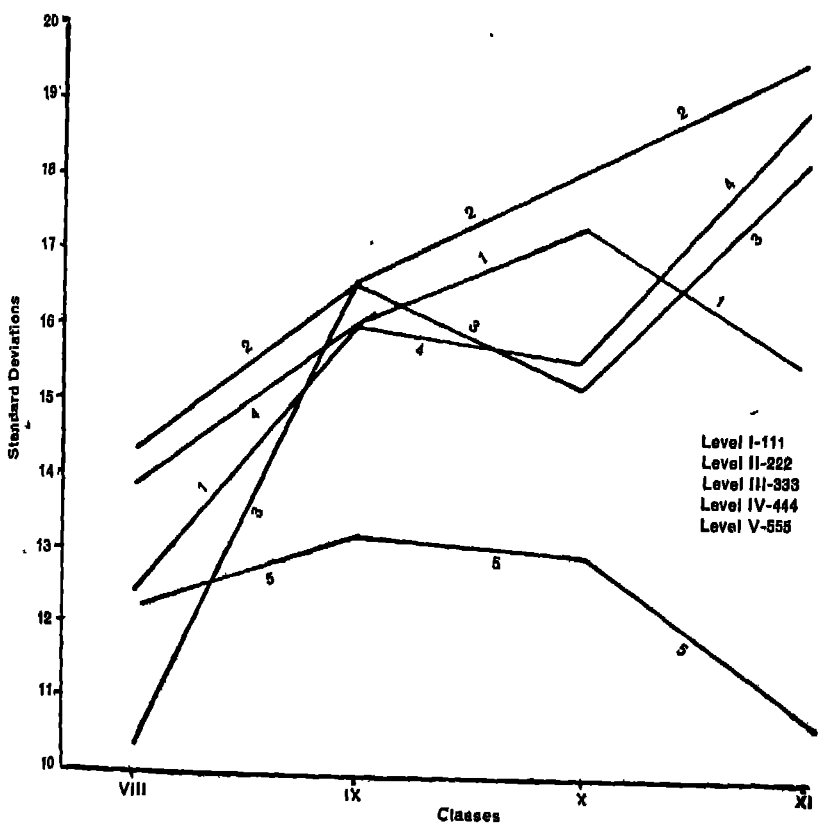


high for all levels of brightness except the fifth. During the third year the rate of growth for the first level further improved but it was reduced for the second, third and fourth levels of brightness; however, the growth for the fifth level was much accelerated. Thus the brightest group maintained its superiority, the three middle levels came nearer in clerical ability while the dullest remained inferior to all others.

The standard deviation curves for the five levels of brightness are shown in Figure 4(b).

FIGURE 4 (b)

Curves for the Standard Deviations of Clerical Scores



From Figure 4(b) it is observed that the standard deviations for all levels of brightness have not remained constant throughout; for the first four levels they have increased and for the fifth levels they have decreased. We know that during growth of a function or a structure standard deviation increases, in part because of increasing individual differences in capacity, and in part because of individual differences in the speed with which the maturing process takes place. These two factors are known to be operative in physical growth and appear to be operating in clerical ability (perceptual speed and accuracy) more than the growth of other abilities. During the growth process when both factors operate freely, which appears to be the case with first four levels of brightness, the variability of scores become greater with the general increments in the structure of function concerned. But as an increasing number of individuals stop growing, which appears to be the case with fifth level of brightness, the means level off to a constant value, the individual differences narrow down and are indicative of the achieved mature state. The results also show that during the stage of development under investigation, had speed and accuracy been developing successively (and not simultaneously as one variable) like two different functions then it would have resulted in alternating periods of increasing and decreasing variability.

The significance of difference between means of consecutive pairs of groups for each level of brightness was tested; the results are set out in Table 28.

The growth of clerical ability for the brightest group was significant during the first year only, from class VIII to class IX but afterwards there was no significant change. For the three middle levels of brightness there was significant growth during the first and second years but there was no significant change in the third year. There was no significant growth of clerical ability, for the dullest group, during the first two years but it developed significantly during the third year from class X to class XI.

Thus it appeared that the growth characteristics of the second, third and fourth levels of brightness were alike and were different from those of the brightest and dullest groups, the latter two had also different characteristics. However, the brightest pupils continued to score higher, the duller continued to score lower, and the

Brightness Level	Group I				Group II				D_M	CR/t
	Class/Age	*M*	*S.D.*	*N*	*Class/Age*	*M*	*S.D.*	*N*		
I	VIII/12+	42.45	12.45	88	IX/13+	47.58	16.01	69	5.13	2.19*
	IX/13+	47.58	16.01	69	X/14+	52.42	17.28	59	4.84	1.64
	X/14+	52.42	17.28	59	IX/15+	57.48	15.46	31	5.06	1.42
II	VIII/13+	41.00	14.16	199	IX/14+	46.08	16.53	190	5.08	3.25**
	IX/14+	46.08	16.53	190	X/15+	50.66	16.99	108	4.58	2.26*
	X/15+	50.66	16.99	108	XI/16+	53.77	19.47	96	3.11	1.21
III	VIII/14+	37.33	10.30	123	IX/15+	45.28	16.50	119	7.95	4.48**
	IX/15+	45.28	16.51	119	X/16+	52.34	15.18	102	7.06	3.31**
	X/16+	52.34	15.18	102	XI/17+	54.20	18.17	75	1.86	.72
IV	VIII/15+	35.28	13.78	96	IX/16+	42.84	16.01	77	7.56	3.28**
	IX/16+	42.84	16.01	77	X/17+	49.67	15.59	58	6.83	2.49*
	X/17+	49.67	15.59	58	XI/18+	52.34	18.86	53	2.67	.81
V	VIII/16+	36.67	12.24	15	IX/17+	41.77	13.18	44	5.10	1.37
	IX/17+	41.77	13.18	44	X/18+	42.37	13.04	30	.60	.19
	X/18+	42.37	13.04	30	XI/19+	50.04	10.88	28	7.66	2.43

*Significant at 5% level.
**Significant at 1% level.

three. middle levels came nearer in ability and occupied middle position.

Mechanical Ability

The mean mechanical scores for the five levels of brightness were plotted and the growth curves for each level were drawn which are shown in Figure 5(a).

From Figure 5(a) and Table 29 it is noticed that the growth characteristics of the mechanical scores for the first four levels of brightness are alike. There is retardation during the first year and then there is almost equal acceleration during the next two years. The retardation phenomenon is a peculiar one and reasons for it can be considered when longitudinal data is available. The differences between the mechanical ability scores for the five levels are maintained throughout the three year period. For the fifth level of brightness the retardation is continued in the second year as well, but the growth rate during the third is higher than for any other level of brightness.

The standard deviation curves for the five levels of brightness are shown in Figure 5(b).

From Figure 5(b) it appears that the standard deviation curves for all the levels of brightness are alike and the standard deviation showed an increase from first year to third year, probably due to the increasing individual differences in capacity and the individual differences in the speed of the maturing process taking place in the children.

The significance of difference between means of consecutive groups for each levels of brightness was tested; the results are set out in Table 29.

The retardation in mechanical ability was significant from class VIII to class IX for all levels of brightness. The reason for this special phenomenon will be considered only while analysing the longitudinal data. The growth of mechanical ability from class IX class to class X was significant for first, second and third levels of brightness but the special phenomenon of retardation continued for the dullest group.

From class X to class XI there was significant growth for

FIGURE 5 (a)
Curves for Mean Mechanical Scores

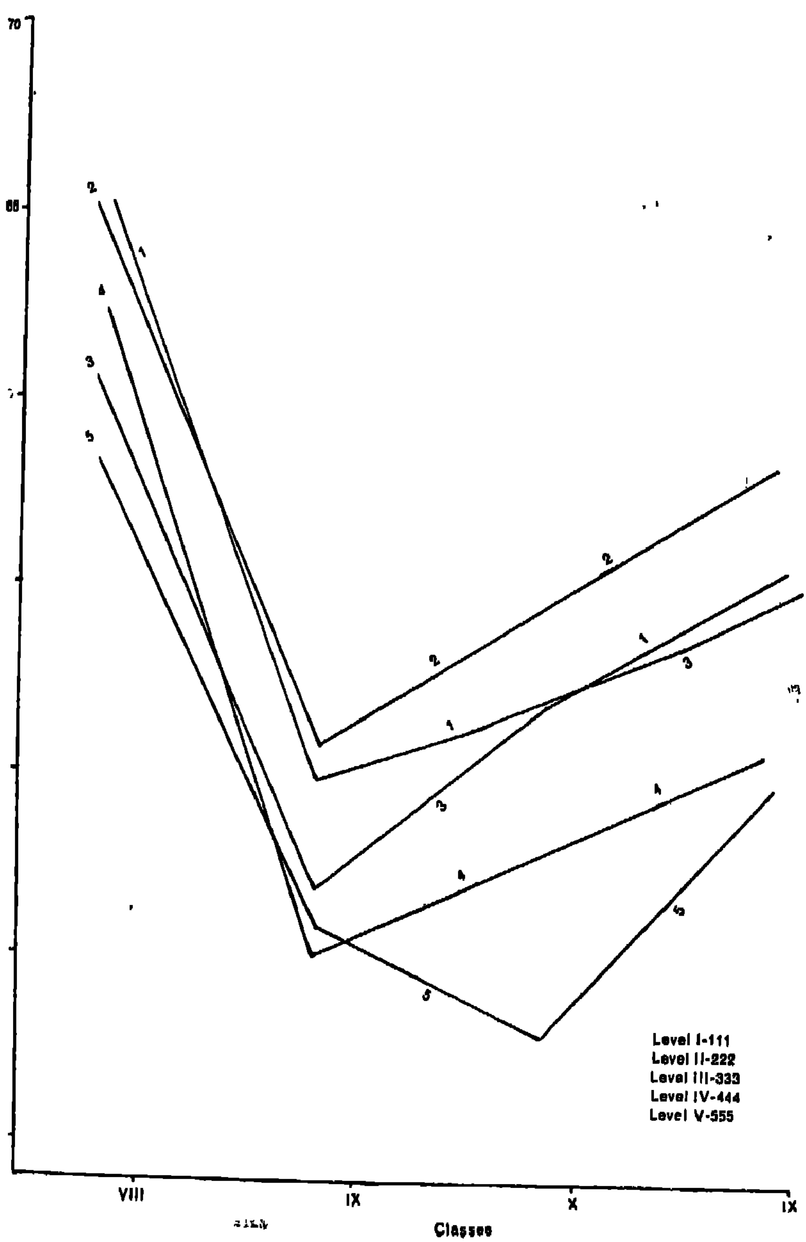


TABLE 29

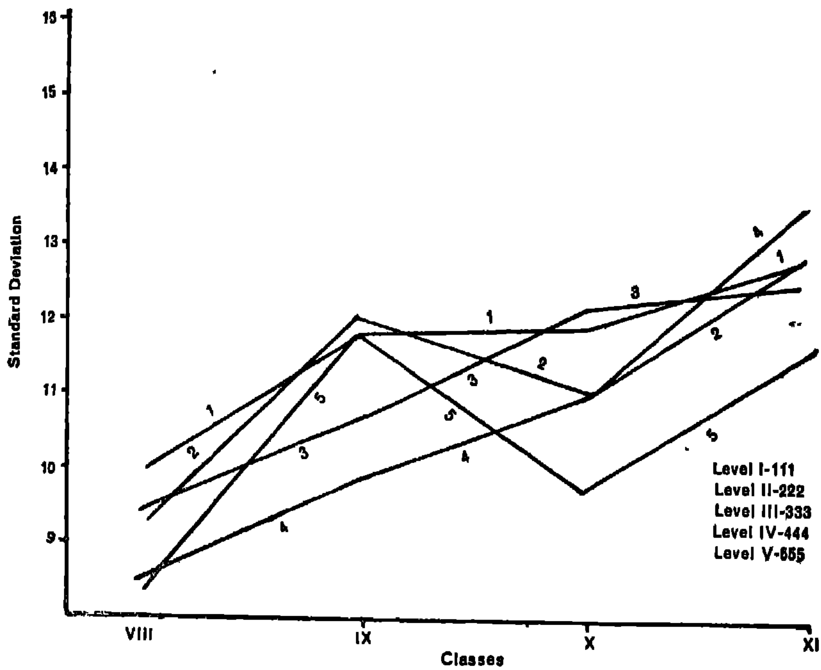
Significance of Difference Between Mean Mechanical Ability Scores for Pupils of Different Age Cum Grade Group

Brightness Level	Group I Class/Age	Group I M	Group I S.D.	Group I N	Group II Class/Age	Group II M	Group II S.D.	Group II N	D_M	CR
I	VIII/12+	65.92	9.87	88	IX/13+	50.04	11.76	69	—15.88	9.00**
	IX/13+	50.04	11.76	69	X/14+	57.68	11.94	59	+7.63	3.63**
	X/14+	57.68	11.94	59	XI/15+	59.00	12.89	31	1.32	.47
II	VIII/13+	65.34	9.20	199	IX/14+	48.97	12.01	190	—16.37	15.04**
	IX/14+	48.97	12.01	190	X/15+	55.24	11.13	108	6.27	4.54
	X/15+	55.24	11.13	108	XI/16+	58.77	12.95	96	3.53	2.08*
III	VIII/14+	61.11	9.44	123	IX/15+	46.87	10.66	119	—14.24	10.99**
	IX/15+	46.87	10.66	119	X/16+	51.51	12.06	102	4.64	3.01**
	X/16+	51.51	12.06	102	XI/17+	54.47	12.62	75	2.96	1.57
IV	VIII/15+	63.41	8.45	96	IX/16+	44.86	9.88	77	—18.55	6.29**
	IX/16+	44.86	9.88	77	X/17+	48.12	11.04	58	3.26	1.78
	X/17+	48.12	11.04	58	XI/18+	50.96	13.56	53	2.84	1.20
V	VIII/16+	59.00	8.33	15	IX/17+	46.43	11.88	44	—12.57	4.49**
	IX/17+	46.43	11.88	44	X/18+	42.83	9.84	30	—3.60	1.46
	X/18+	42.83	9.84	30	XI/19+	50.39	11.58	28	7.56	2.77**

**Significant at 1% level.
*Significant at 5% level.

FIGURE 5 (b)

Curves for the Standard Deviations of Mechanical Ability Scores



second and fifth levels of brightness but the growth of pupils belonging to first, third and fourth levels was not significant.

Thus it appeared that the growth characteristics of mechanical ability were almost similar for all levels of brightness, there was great retardation during the first year but acceleration thereafter (except in case of fifth level of brightness where the retardation continued during the second year as well); the mean mechanical scores were highest at the eighth grade; and the pupils maintained their relative standing (superiority or inferiority) in the mechanical ability, throughout the higher secondary stage.

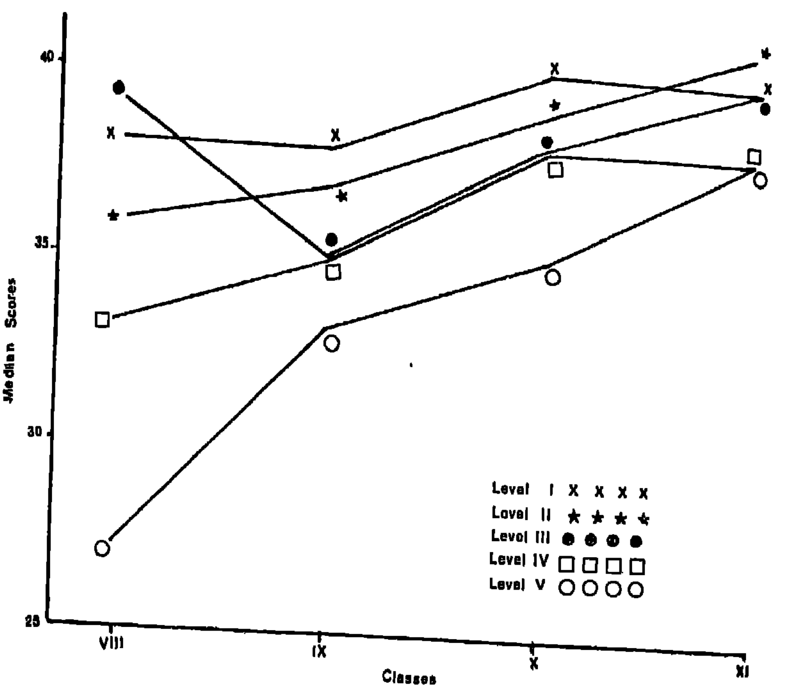
Reasoning Ability

It has been noticed earlier that the distributions of reasoning

ability scores were negatively skewed. Hence for studying the growth of reasoning ability the medians for age-cum-grade groups were worked out, these are shown in Table 30. The growth curves were drawn by plotting the median reasoning scores for the five levels of brightness which are shown in Figure 6.

FIGURE 6

Curves for Median Reasoning Scores



From Figure 6 and Table 30 it is noticed that the growth characteristics of reasoning ability were similar to those of verbal ability. The brighter groups began at a higher level but grew at a slower rate than the duller groups so that the differences between the groups of varying brightness tended to decrease. However, there were noticed two exceptions, firstly there was retardation during the first year for the third level of brightness and that there was no growth during the third year for the fourth level group.

TABLE 30

Medians for Reasoning Ability Scores

Class/Age	12+	13+	14+	15+	16+	17+	18+	19+
VIII	39.79	37.77	35.95	33.36	26.13			
IX	—	38.41	38.09	36.84	35.38	34.00		
X	—	—	40.69	39.77	39.47	39.70	36.50	
XI	—	—	—	40.33	41.13	41.26	39.18	39.36

As the distributions of reasoning ability were significantly negatively skewed the Median Test was used to determine the differences in central tendencies of various age-cum-grade groups.

From the above Table it appears that the growth characteristics of reasoning ability for the first and second levels of brightness were almost similar. There was no significant growth in reasoning ability from class VIII to class XI. For the third level of brightness there was no significant growth from class VIII to class IX but the growth from class IX to class X as also from class X to class XI was significant. At the eleventh class there were no significant differences between the three levels—first, second and third. The growth, for the fourth level was significant from class IX to class X only and it was not significant in other years. The growth for fifth level of brightness was significant from class VIII to class IX only but the rate of growth was such that at the eleventh class level there were no differences between the median scores of pupils of fourth and fifth levels of brightness.

Thus it appeared that the growth characteristics of the reasoning ability were different for the five levels of brightness, but a plateau more or less appeared, for the first, second and fifth levels of brightness during the eleventh class and the differences in median scores at the eighth class tended to decrease at the eleventh grade.

Numerical Ability

Like the distributions of reasoning ability scores the distributions

TABLE 31

Significance of Differences Between Median Reasoning Scores

Sl No.	Group	Combined Median	Above Median Group I	Above Median Group II	Below Median Group I	Below Median Group II	Significance 5%	Significance 1%	Chi Square
1.	VIII/12+ & IX/13+	39.23	48 (44.28)	31 (34.72)	40 (43.72)	38 (34.28)	No	No	1.43
2.	IX/13+ & X/14+	39.50	29 (34.50)	35 (29.50)	40 (34.50)	24 (29.50)	No	No	3.80
3.	X/14+ & IX/15+	40.55	30 (29.50)	15 (15.50)	29 (29.50)	16 (15.50)	No	No	0.05
4.	VIII/13+ & IX/14+	37.95	98 (99.75)	97 (95.24)	101 (99.24)	93 (94.75)	No	No	0.13
5.	IX/14+ & X/15+	38.78	86 (95.00)	63 (54.00)	104 (95.00)	45 (54.00)	Yes	No	4.70
6.	X/15+ & XI/16+	40.42	48 (54.00)	54 (48.00)	60 (54.00)	42 (48.00)	No	No	2.83
7.	VIII/14+ & IX/15+	35.90	62 (61.50)	59 (59.50)	61 (61.50)	60 (59.50)	No	No	0.02
8.	IX/15+ & X/16+	37.85	45 (59.77)	66 (51.23)	74 (59.23)	36 (50.77)	Yes	Yes	15.89
9.	X/16+ & XI/17+	40.15	44 (51.28)	45 (37.71)	58 (50.71)	30 (37.28)	Yes	No	4.92
10.	VIII/15+ & IX/16+	34.13	43 (48.27)	44 (38.72)	53 (47.72)	33 (38.27)	No	No	2.61
11.	IX/16+ & X/17+	37.68	30 (38.21)	37 (28.78)	47 (38.78)	21 (29.32)	Yes	Yes	8.16
12.	X/17+ & XI/18+	39.48	30 (28.78)	25 (26.26)	28 (29.26)	28 (26.73)	No	No	0.23
13.	VIII/16+ & IX/17+	31.75	3 (7.37)	26 (21.63)	12 (7.62)	18 (22.37)	Yes	Yes	6.84
14.	IX/17+ & X/18+	35.23	20 (22.00)	17 (15.00)	24 (22.00)	13 (15.00)	No	No	0.90
15.	X/18+ & XI/19+	37.83	12 (15.00)	17 (14.00)	18 (15.00)	11 (14.00)	No	No	2.49

Note : 1. Figures in brackets indicate the corresponding Expected Frequencies Above and Below the Combined Medians.
2. The value of χ^2 for 1 degree of freedom on 5% and 1% level of significance are 3.841 and 6.635 respectively as given in Fisher and Yates-Table.

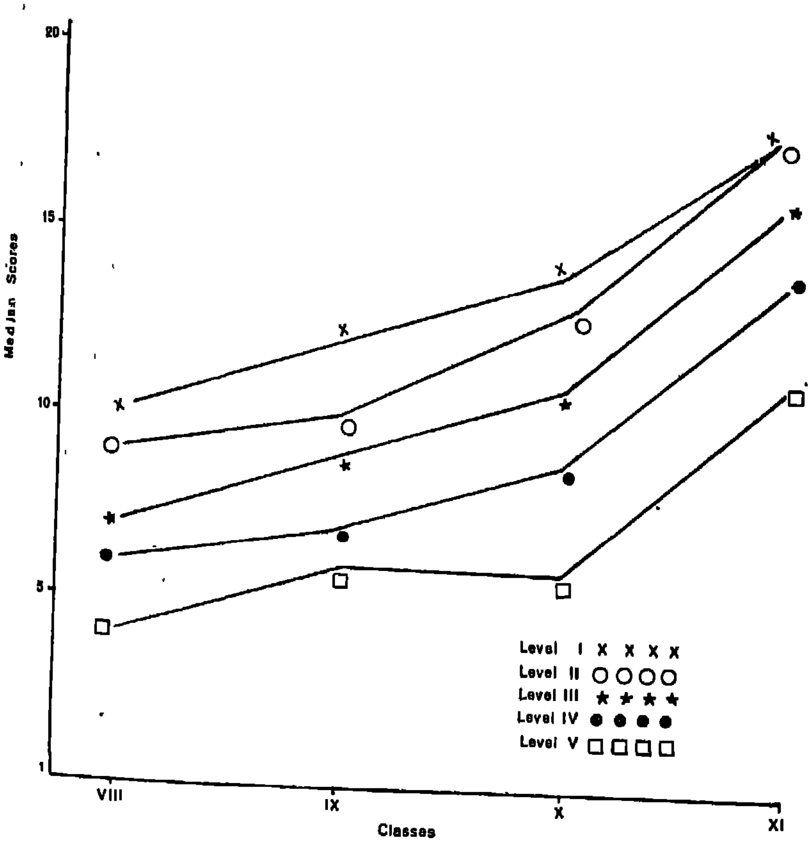
TABLE 32

Melians for Numerical Ability Scores

Class/Age	12+	13+	14+	15+	16+	17+	18+	19+
VIII	10.00	8.81	6.07	5.25	3.40			
IX	—	11.65	9.45	8.88	6.72	5.50		
X	—	—	13.55	10.90	10.20	8.77	4.50	
XI	—	—	—	16.38	17.73	14.31	12.00	10.00

FIGURE 7

Curves fcr Median Numericul Scores



of numerical ability scores were also highly skewed and deviated significantly from normal curve. The latter distributions were positively skewed. Hence for studying the growth of numerical ability the medians for age-cum-grade groups were worked out, they are shown in Table 32. The median scores were plotted to draw the growth curves which are shown in Figure 7.

From Figure 7 and Table 32 it is evident that the growth characteristics of numerical ability for the five levels of brightness are almost similar. The growth is continuous throughout the three year period (except during second year for the dullest group) and the rate is high during the last year. The difference between first and second levels of brightness vanish at the end of third year but the differences in numerical ability between other levels remained as they were at the eighth grade.

The significance of the difference between medians of consecutive pairs of groups for each level of brightness was tested by using the Median Test. The results are set out in Table 33.

From Table 33 it is noticed that there was no significant growth of numerical ability, for the first level of brightness, over the three year period. For second, fourth and fifth levels of brightness, there was significant growth from class X to class XI only. However, growth for the third level of brightness was significant from class VIII to class IX as also from class X to class XI.

Thus it appeared that the growth characteristics of the numerical ability were almost similar for the five levels of brightness and the relative standing in numerical ability, superiority or inferiority, was generally maintained from classes eight through eleventh.

Abilities of the Modal Age Group

Since raw test scores vary considerably in meaning, they cannot be used in comparing growths of different abilities. The raw scores for different tests have different means and ranges, for example, the raw scores on the verbal ability test vary from 0 to 64 while those on the numerical ability test vary from 0 to 35. Thus it is obvious that one ability would appear to grow more than the other. Therefore for the purpose of achieving comparability of growth of abilities it is necessary to reduce the scores to some comparable form.

TABLE 33

Significance of Difference Between Median Numerical Scores

S. No.	Group	Combined Median	Above Median Group I	Above Median Group II	Below Median Group I	Below Median Group II	Significance 5%	Significance 1%	Chi-Square
1.	VIII/12+ & IX/13+	10.75	40 (43.72)	38 (34.28)	48 (44.28)	31 (34.72)	No	No	1.43
2.	IX/13+ & X/14+	12.64	31 (34.50)	33 (29 50)	38 (34.50)	26 (29.50)	No.	No	1.54
3.	X/14+ & XI/15+	14.33	27 (29.50)	18 (15.50)	32 (29.50)	13 (15.50)	No	No	1.23
4.	VIII/13+ & IX/14+	9.10	95 (99.24)	99 (94.76)	104 (99.76)	91 (95.24)	No	No	0.74
5.	IX/14+ & X/15+	9.95	89 (95.00)	60 (54.00)	101 (95.00)	48 (54.00)	No	No	2.09
6.	X/15+ & XI/16+	15.17	41 (54.00)	61 (48.00)	67 (54.00)	35 (48.00)	Yes	Yes	13.30
7.	VIII/14+ & IX/15+	7.28	48 (61.50)	73 (59.50)	75 (61.50)	46 (59.50)	Yes	Yes	12.05
8.	IX/15+ & X/16+	9.47	54 (59.77)	57 (51.23)	65 (59.23)	45 (50.77)	No	No	2.42
9.	X/16+ & XI/17+	11.30	43 (51.29)	46 (37.71)	59 (50.71)	29 (37.29)	Yes	No	6.36
10.	VIII/15+ & XI/16+	5.79	43 (47.72)	43 (38.28)	53 (48.28)	34 (38.72)	No	No	2.09
11.	IX/16+ & X/17+	7.52	34 (38.21)	33 (28.79)	43 (38.79)	25 (29.21)	No	No	2.15
12.	X/17+ & XI/18+	10.20	24 (29.26)	32 (26.74)	34 (28.74)	21 (26.26)	Yes	No	4.00
13.	VIII/16+ & IX/17+	4.63	5 (7.37)	24 (21.63)	10 (7.63)	20 (22.37)	No	No	2.01
14.	IX/17+ & X/18+	5.20	23 (22.00)	14 (15.00)	21 (22.00)	16 (15.00)	No	No	0.22
15.	X/18+ & XI/19+	6.83	11 (15.00)	18 (14.00)	19 (15.00)	10 (14.00)	Yes	No	4.42

Note : 1. Figures in brackets indicate the Expected Frequencies Above and Below the corresponding Combined Medians
2. The valve of χ^2 for degree of freedom on 5% and 1% levels of significance are 3.841 and 6.635 respectively. as given in Fisher's and Yate's Tables.

The combined means and standard deviations from the means and standard deviations for the four class groups of modal age were first found out for each ability and the mean scores were then expressed on another scale of mean 50 and standard deviation 10. The converted scores are shown in Table 34 and the growth curves obtained by plotting them are shown in Figure 8; the growth angles and growth rates are given in Appendix IV.

From Table 34 and Figure 8 it is noticed that the growth curves for verbal, reasoning and clerical abilities are almost similar. There is continuous growth of these abilities throughout the three year period but the rate of growth is highest from class IX to class X. The scores for the three abilities at class VIII are nearly the same and they are also equal at class XI. The growth of numerical ability is also constant throughout the three year period

FIGURE 8

Changes in Ability Scores for the Modal Age Group

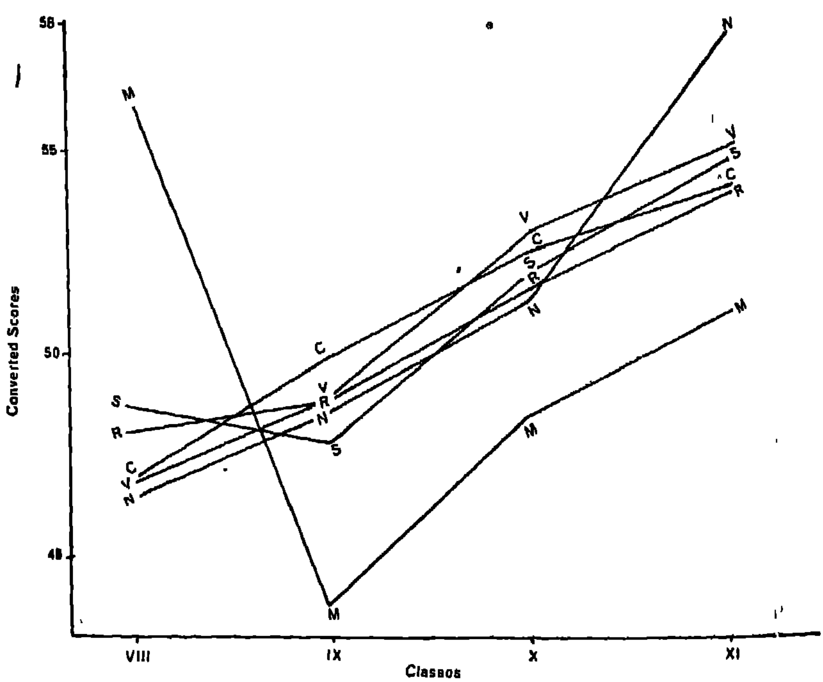


TABLE 34

Converted Ability Scores for Modal Age Group

Ability/Class	*VIII*	*IX*	*X*	*XI*
V	46.73	48.98	53.17	55.25
R	48.13	48.86	51.71	54.18
N	46.55	48.65	51.44	58.23
S	48.69	47.79	51.95	54.89
C	46.80	49.78	52.48	54.30
M	56.27	43.67	48.50	51.22

but the growth rate from class X to class XI is very high with the result that the numerical ability scores exceed the scores of other abilities at class XI. The growth curves of spatial and mechanical abilities were similar in so far as there is retardation from class VIII to class IX and continuous growth thereafter; the growth rate being highest from class IX to class X. However the retardation from class VIII to class IX of mechanical ability is extraordinary and reasons thereof will be considered while analysing longitudinal data.

Conclusion

The growth curves, or better age progress curves, for the six abilities—verbal, reasoning, spatial, numerical, clerical and mechanical exhibited different characteristics. The growth curves for verbal and reasoning were almost similar; the brighter groups began at a higher level but grew at a slower rate than the duller groups so that the differences between the groups of varying brightness, noticed at the eighth grade, tended to decrease at the eleventh grade. The growth curves for numerical, clerical and mechanical had almost similar characteristics; the rate of growth for pupils of different degrees of brightness was almost equal and, therefore, the differences between the ability scores for the five levels, noticed at the eighth grade, were maintained throughout the three year period. The growth curves of spatial ability indicated that the brighter groups not only began at a higher level but tended to grow at a faster rate so that the differences between the brighter and duller groups,

observed at the eighth grade, had increased at the eleventh grade.

The growth of abilities for the modal age group indicated that the growth characteristics of verbal, reasoning and clerical abilities were almost similar, all these abilities continued to grow throughout the higher secondary classes while the rate of growth was maximum from class IX to class X. The growth of spatial and mechanical abilities again were similar; there was retardation from class VIII and class IX but continuous growth thereafter. The growth of numerical ability was constant throughout the three year period but there was high acceleration from class X to class XI with the result that the numerical ability scores exceeded the scores of all other abilities at class XI.

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Appendix I

TABLE (i)

Agewise Distribution of Students in Different Grades

Age/Grade	10+	11+	12+	13+	14+	15+	16+	17+	18+	19+	20+	21+	22+	23+	*Total*
VIII	1	15	177	251	152	114	22	22	7	2	1	1	2	—	767
IX	—	1	32	101	261	157	106	52	9	7	3	—	1	—	730
X	—	—	1	15	78	159	155	92	67	14	14	26	1	1	623
XI	—	—	—	—	3	50	144	127	115	46	12	8	3	—	508
Total	1	16	210	367	494	480	427	293	198	69	30	35	7	1	2628

TABLE (ii)

Agewise Distribution of Students about Whom Data on All Tests was Available

Grade Age	12+	13+	14+	15+	16+	17+	18+	19+	Total
VIII	88	199	123	96	15	—	—	—	521
IX	—	69	190	119	77	44	—	—	499
X	—	—	59	108	102	58	30	—	357
XI	—	—	—	31	96	75	53	28	283

N.B. The age was calculated on October 1, 1963 and was reported to nearest birth day.

TABLE (iii)

Means and S.D. of Total Group and Sample

Ability		Total Group M	Total Group S.D.	Sample M	Sample S.D.	Difference between means	C.R.
V	C VIII	25.19 (615)	13.35	26.12 (521)	13.37	0.93	1.16
	C XI	37.77 (615)	11.45	38.57 (283)	11.40	0.80	.91
R	C VIII	34.84 (638)	7.47	35.41 (521)	7.49	0.57	1.27
	C XI	39.27 (429)	5.94	39.46 (283)	6.04	0.19	.41
N	C VIII	7.88 (614)	5.50	7.85 (521)	5.48	0.03	.09
	C XI	15.01 (409)	8.70	15.67 (283)	8.60	0.66	.99
S	C VIII	21.44 (640)	11.65	22.70 (521)	11.88	1.26	1.82
	C XI	29.95 (402)	12.85	29.93 (283)	13.32	.02	.02
C	C VIII	38.70 (616)	13.36	39.20 (521)	13.18	.50	.60
	C XI	53.01 (410)	18.25	52.65 (283)	18.17	.36	.26
M	C VIII	62.69 (614)	10.05	63.00 (521)	9.43	.31	.54
	C XI	54.42 (396)	12.90	55.08 (283)	13.21	.66	.65

A Study of Relationship between Size, Costs and Efficiency of Secondary Schools*

C. L. Sapra

Efficiency of a school is defined as performance of pupils in the examinations of the Central Board of Secondary Education and such aspects of pupils' development as work-experience, citizenship training, etc., which are not evaluated in external examination and for the training of which the school is not exclusively responsible, have been left out. A systematically selected random sample of 51 *of the* 256 *government higher secondary schools of Delhi studied here shows negative but statistically insignificant relationship between size of school and educational efficiency both raw and adjusted for factors like class size, teachers' qualifications, status of school building etc. Teaching costs per pupil show an inverse relationship with school size upto and between* 750 *and* 850 *pupils. No appreciable fall in*

*This paper was submitted by the author to the Asian Institute of Educational Planning and Administration, New Delhi in February, 1971, in fulfilment of the requirements of the XIth Training Course for Educational Planners and Administrators. The study is confined to government high/higher secondary schools of Delhi/New Delhi.

cost per pupil is seen when school size increases beyond this.

There has been unprecedented expansion of educational facilities at all levels in the Union Territory of Delhi during the post-independence period due to demographic factors, large scale in-migration of people from the adjoining States to Delhi and Government policy of providing free, compulsory and universal primary education for all children up to the age of 14 (Directive Principle under Article 45 of the Indian Constitution)** and increasing social and economic demands for education. In government high/higher secondary schools (general education), for example, the number of pupils increased from 9,258 to 1,72,378 between 1951 and 1970. The corresponding increase in the number of government high/higher secondary schools was from 16 to 278. The figures in respect of the differentials between urban and rural schools and between boys and girls schools during this period, may be seen in Tables 1 and 2. The discrepancy between the increase in the number of institutions and the enrolment implies that in urban areas, relatively a small number of new schools were opened during 1951-70 and a substantial part of additional enrolment was accommodated in the then existing schools (this is particularly true of girls schools), while in rural areas, the increase in the number of schools was much higher than that in the enrolment. These two developments indicate that a large number of schools in urban areas became unwieldly, while in rural areas a large majority of small-sized schools were opened. This is further borne out by the figures set out in Tables 3 and 4. The average sizes of schools shown in Table 3, however, do not present a true picture, because the enrolment in some schools was as low as less than 200, while in some others it was as high as over 2,000.

It follows from the foregoing that the size of schools is an

**This has generated pressures on secondary and higher education.

TABLE 1

Number of Government High/Higher Secondary Schools in Delhi (1951-70)

	Urban			*Rural*			*Total (Urban and Rural)*		
	Boys Schools	*Girls Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*
1950-51	9 (—)	5 (—)	14 (—)	2 (—)	— (—)	2 (—)	11 (—)	5 (—)	16 (—)
1955-56	30 (233.3)	25 (400.0)	55 (292.9)	4 (100.0)	— (—)	4 (100.0)	34 (209.1)	25 (400.0)	59 (268.8)
1960-61	71 (688.9)	55 (1000.0)	128 (800.0)	26 (1100.0)	4 (—)	40 (1400.0)	97 (781.8)	59 (1080.0)	156 (875.0)
1965-66	105 (1066.7)	95 (1800.0)	200 (1328.6)	32 (1500.0)	8 (100.0)	40 (1900.0)	137 (1145.5)	103 (1960.0)	240 (1400.0)
1969-70	122 (1265.6)	113 (2160.0)	235 (1578.6)	34 (1600.0)	9 (125.0)	43 (2050.0)	156 (1318.2)	122 (2340.0)	278 (1637.5)

Source : Directorate of Education, Delhi.

Note : Figures in parentheses indicate percentage increase over the number of schools in 1950-51 except for rural girls schools in which case the increase is over the number of schools in 1960-61.

TABLE 2

Enrolment in Govt. High/Higher Secondary Schools in Delhi (1951-1970)

	Urban			Rural			Total (Urban and Rural)		
	Boys Schools	*Girls Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*
1950-51	6,280 (—)	1,663 (—)	7,943 (—)	1,315 (—)	— (—)	1,315 (—)	7,595 (—)	1,663 (—)	9,258 (—)
1955-56	27,278 (334.4)	19,803 (1090.8)	47,081 (492.7)	2,252 (71.3)	— (—)	2,252 (71.3)	29,530 (288.8)	19,803 (1090.8)	49,333 (432.9)
1960-61	46,879 (646.5)	35,254 (2019.9)	82,133 (934.0)	9,893 (652.3)	1,752 (—)	11,645 (785.6)	56,772 (647.5)	37,006 (2125.3)	93,778 (912.9)
1965-66	70,278 (1019.1)	50,713 (2949.5)	1,20,991 (1423.0)	12,930 (883.3)	3,125 (78.4)	16,055 (1120.9)	83,208 (995.6)	53,838 (3137.4)	1,37,046 (1380.3)
1969-70	83,340 (1227.1)	69,183 (4060.1)	1,52,523 (1820.2)	16,134 (1126.9)	3,721 (112.4)	19,855 (1409.0)	99,474 (1209.7)	72,904 (4283.9)	172,378 (1761.9)

Source : Directorate of Education, Delhi.

Note : Figures in parentheses indicate percentage increase over the enrolment in 1950-51 except for rural girls schools in which case the increase is over the enrolment in 1960-61.

TABLE 3

Average Size of Government Higher Secondary Schools in Delhi—1969-70

	Urban			*Rural*			*Total (Urban and Rural)*		
	Boys Schools	*Girls Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*
(*i*) Number of Govt. Hr. Sec. School	122	113	235	34	9	43	156	122	278
(*ii*) Enrolment (in Classes VI-XI)	82,627	69,928	1,52,555	16,141	2,505	18,646	98,768	72,433	1,71,201
(*iii*) Average Size of a Govt. Hr. Sec. School	677	619	649	475	278	434	633	594	1,227

Source : Directorate of Education, Delhi.

TABLE 4

Number of Government Higher Secondary Schools in Delhi by Pupil Strength—1969-70

Enrolment in Calsses VI-XI	*Urban*			*Rural*			*Total (Urban & Rural)*		
	Boys Schools	*Girls Schools*	*Total*	*Boys Schools*	*Girl Schools*	*Total*	*Boys Schools*	*Girls Schools*	*Total*
Less than 400	21 (17.2)	20 (17.7)	41 (17.4)	9 (26.5)	6 (66.7)	15 (34.9)	30 (19.2)	26 (21.3)	56 (20.1)
400—500	15 (12.3)	17 (15.0)	32 (13.6)	10 (29.4)	3 (33.3)	13 (30.3)	25 (16.0)	20 (16.4)	45 (16.2)
500—600	20 (16.5)	18 (15.9)	38 (16.2)	9 (26.5)	—	9 (20.9)	29 (18.6)	18 (14.8)	47 (16.9)
600—700	14 (11.5)	17 (15.0)	31 (13.2)	5 (14.7)	—	5 (11.6)	19 (12.2)	17 (13.9)	36 (12.9)
700—800	17 (13.9)	14 (12 4)	31 (13.2)	—	—	—	17 (10.9)	14 (11.5)	31 (11.2)
800—900	8 (6.5)	12 (10.6)	20 (8.5)	1 (2.9)	—	1 (2.3)	9 (5.8)	12 (9.8)	21 (7.6)
900—1,000	8 (6.5)	11 (9 8)	19 (8.1)	—	—	—	8 (5.1)	11 (9.0)	19 (6.8)
Above 1,000	19 (15.6)	4 (3.6)	23 (9.8)	—	—	—	19 (12.2)	4 (3.3)	23 (8.3)
	122 (100.0)	113 (100.0)	235 (100.0)	34 (100.0)	9 (100.0)	43 (100.0)	156 (100.0)	122 (100.0)	278 (100.0)

Source : Directorate of Education, Delhi.

Note : Figures in parentheses indicate percentages total.

important problem. Too large institutions become unmanageable and are, therefore, likely to affect educational efficiency adversely, while institutions too small may not permit economies of cost. The problem of school size assumes greater significance in developing countries, where resources are scarce. Unabated expansion of educational facilities in these countries is inevitable in the years to come. Large-sized institutions in urban areas and small-sized institutions in rural areas are also bound to spring up due to the rising social demand for education and local and political pressures. The only way to get over this difficulty appears to be to have optimum-sized institutions which are neither too large nor too small. There is a general feeling that such institutions are economically viable and educationally efficient.

Underlying whatever has been said in the preceding paragraph is the assumption that there is a relationship between the size of schools, their costs and their efficiency. The purpose of this study is to examine this relationship. The likely outcomes of the study would be: (i) the knowledge about the relationship between these three variables, and (ii) the knowledge about the maximum permissible size of a secondary school which could help in minimising costs and maximizing efficiency.

2. *Definition of Terms*

The terms 'size of schools', 'educational costs', and 'educational efficiency' are defined differently by different people. For example, the size of schools is defined either in terms of the number of pupils or the number of classes*. The relation between the number of pupils and the number of classes per school was examined more closely for several years by means of regression analysis in a study[1] and the correlation between the two variables was found to be very high ($r = .997$), so that one quantity could be substituted for the other. Similarly, educational costs can

*Here the term 'classes' means 'sections'. A grade or class may have one or more than one sections.

[1]Netherlands Central Bureau of Statistics (Department of Cultural and Educational Statistics), Size and Costs of Secondary Grammar Schools, The Hague: 1965, p. 4.

be defined in terms of costs to the Government, costs to the parents and costs to the society. Again, educational costs can be of two types—capital and recurring. Educational efficiency is also defined in terms of 'internal efficiency' and 'external efficiency'. Internal efficiency is related to the input-output ratio based on the rates of dropouts and repetition for a cohort of pupils. External efficiency is concerned with the extent of employability of pupils who leave school after completing the course of education in which they were admitted. In view of a variety of connotations of these terms, it may be appropriate to give below their exact definitions as adopted for the purpose of this study.

Size of Schools

The size of schools at a particular point of time means the number of pupils enrolled in all the classes that the school under study provides.

Educational Costs

Educational costs include the recurrent expenditure incurred by the Government on salaries and allowances of teaching and non-teaching staff and on all other items of recurring nature. Governmental expenditure on school buildings* and the amounts spent by the parents on the education of their children have been left out of consideration. Capital expenditure on library, furniture and equipment has also not been taken into account because of inaccuracies in data.

Educational Efficiency

Educational efficiency has been defined for the purpose of this study as the pupils' performance in the higher secondary examination conducted by the Central Board of Secondary Education. This definition has been adopted because pupils' performance in the external

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*Information in respect of expenditure on school buildings is not available in the school records, because accounts for this item are maintained by the Public Works Department.

examination appears to provide a common yard-stick to evaluate schools, howsoever doubtful the reliability and validity of the external examinations may be. Such aspects of pupils' development as work-experience, citizenship training, etc. which are not evaluated in the external examination, and for the training of which school is not exclusively responsible, have been left out.

3. *Conceptual Framework*

As stated earlier, the purpose of the present study is to examine relationship between three variables viz. size of schools, their costs and efficiency. As regards costs-size relationship, it may be assumed that increase in the recurrent expenditure of schools seen in relation to increase in additional enrolment is always less than the proportionate. Based on this assumption, one can find out the relative significance of the cost-reducing effect on an additional increase of every 100 pupils. While considering relationship between costs and efficiency and size and efficiency, it may be assumed that with the increase in total costs and decrease in size of schools, their efficiency will improve. It is possible that a point may be reached when the per pupil cost does not decrease appreciably with increasing enrolment in a school. Likewise educational efficiency does not improve very much as school size falls below a certain limit.

In the previous section, educational efficiency has been operationally defined in terms of pupils' performance (pass %) in the external examination. But this may not give us a true measure of educational efficiency because pupils' performance (pass %) in the external examination can be adversely or favourably affected by many factors. These factors can be broadly classified into three categories viz. pupil factors, family factors and school factors. Pupil factors may include: (i) level of intelligence, (ii) scholastic aptitude, (iii) regularity in attendance, (iv) motivation for learning, (v) distance of school from the residence of pupils, etc. Factors specific to family area may include: (i) socio-economic background of the family, (ii) educational status of the family, etc. School factors may include: (i) chronological age of school, (ii) size of school, (iii) average size of class, (iv) pupil-teacher ratio, (v) shift system, (vi) average space per pupil, (vii) per pupil expenditure on furniture, equipment and

library, (viii) status of school building, (ix) position regarding availability of furniture and teaching aids, (x) age of teachers, (xi) teachers' qualifications, (xii) teachers' experience, (xiii) teachers' inservice education (xiv) distance of school from teachers' residence, (xv) teachers' workload, (xvi) teachers' motivation and enthusiasm for teaching, (xvii) provision of co-curricular activities, (xviii) provision of guidance services, (xix) provision of special programmes for the gifted and educationally backward pupils, (xx) provision of student-freeships and scholarships, (xxi) provision of mid-day meals, etc. This list of factors in the 'pupil' area, 'family' area, and 'school' area is by no means exhaustive. Many more factors can be identified and added to this list.

Some of the factors mentioned above appear to be positively correlated, while others are likely to be negatively correlated with educational efficiency. To obtain a more meaningful and a reliable index of efficiency, educational efficiency in the present study has been adjusted for each school in relation to six important school factors, namely, average size of class, status of school building, percentage of trained teachers, teacher-pupil ratio, average qualifications and average experience of a teacher. To put it more explicitly, adjusted index of educational efficiency has been constructed for each school by giving a higher rating to those schools which show good results in spite of some handicaps (e.g. large class size, which is negatively related to efficiency) and by giving a lower rating to those which show good results, but have some advantages (e.g. small class size, better qualified teachers, etc.)

II

Methodology and Procedure

1. *The Sample*

There were 453 higher secondary schools in Delhi in 1969-70, out of which 278 were government schools. The present study is confined to government higher secondary schools only because the inclusion of private aided schools in the sample would have introduced another intervening variable.

While drawing sample for the study, all those schools which were not full-fledged* schools for at least three years, were left out from the list, so that there were 256 full-fledged government higher secondary schools with three-year standing in 1969-70. Out of these, 51 schools (20%) were drawn for the study on a systematic sampling basis, taking every fifth school from the list starting from serial No. 3 (a number randomly selected out of the Nos. 1-5), so that schools at serial Nos. 3, 8, 13, 18, 23 and so on, were chosen for the sample. The details in respect of the sample may be seen in Table 5.

2. *Collection and Quantification of Data*

A draft questionnaire was developed to collect data for the purpose of this study. Draft questionnaires was modified on the basis of a try-out in two schools. The final version of the questionnaire was mailed to 51 sampled schools through the Directorate of Education, Delhi. Of these, 26 schools responded. Five responses were not usable, so that the data from 21 schools were processed for purpose of analysis. Besides, information in respect of certain items received from some of these schools could not be used because of incompleteness and inaccuracies.

The data regarding class-wise enrolment, recurring expenditure, examination results**, etc., were collected for three years, i.e., 1968, 1969 and 1970, not to study trends but to smooth out any special conditions operating in some schools in a single year. Smoothing out was done by averaging the data.

The scheme followed for quantification of data and for construction of some of the indices used in this study, is as follows:

Average size of a class has been calculated by dividing the total number of pupils in a class (E) by the total number of sections or classrooms in that class, i.e. $\frac{E}{a}$

The status of a school building is determined by such factors as

*A full-fledged higher secondary school in Delhi means a school having all the three higher secondary classes, viz., IX, X and XI.

**Data in respect of examination results for the years 1969 and 1970 were used as the figures for 1968 were not readily available.

TABLE 5

Sample drawn from Government Higher Secondary Schools of Delhi, 1969-70

Urban				*Rural*				*Total (Urban and Rural)*					
Boys		*Girls*		*Boys*		*Girls*		*Boys*		*Girls*		*Grand Total*	
Total No. of schools	*No. of sampled schools*	*Total No. of schools*	*No. of sampled schools*	*Total No. of schools*	*No. of sampled schools*	*Total No. of schools*	*No. of sampled schools*	*Total No. of schools*	*No. of sampled schools*	*Total No. of schools*	*No. of sampled schools*	*Total No. of schools*	*No. of sampled schools*
1	2	3	4	5	6	7	8	9	10	11	11	13	14
110	23	105	20	31	6	8	2	143	29	113	22	256	51
(excluding 10 newly established)		(excluding 8 newly established)		(excluding 3 newly established)		(excluding 1 newly established)		(excluding 13 newly established)		(excluding 9 newly established)		(excluding 22 newly established)	

its nature*, its location and the facilities provided within the school The information in respect of these three variables has been quantified as follows:

A school which has all pucca classrooms of officially prescribed size gets 5 scores, a school where 4/5th of the classes are held in pucca classrooms and 1/5th in tents gets 4 scores, and so on. A school which satisfies all the conditions of ideal location (viz. healthy place, quiet place, free from dust, free from heavy traffic and provided with drainage/sewage disposal facilities) gets 5 scores (1 score for each condition). A school which does not satisfy any of these conditions gets 0 score. Again, a school which has provision for electricity in all rooms, electric fans in all rooms, power for heating, etc. and adequate drinking water facilities has been given 4 scores (1 score for each facility). A school which does not have provision for any of these facilities gets 0 score. The adequacy of sanitary arrangements in schools has been determined on a 3-point scale viz. very satisfactory, satisfactory and unsatisfactory. The schools which have adequate number of flush-out urinals and lavatories both for teachers and pupils are considered as very satisfactory; those which have adequate number of flush-out/ordinary or exclusively ordinary urinals and lavatories both for teachers and pupils are considered as satisfactory; and those which have very poor sanitary arrangements are considered as unsatisfactory. The adequacy of urinals and lavatories has been determined on the basis of one lavatory and two urinals for every 100 persons (pupils and teachers).

While calculating *average qualifications of a teacher* in a school, matriculation and intermediate have been ignored because of the lack of uniform pattern of qualifications possessed by teachers at these two levels.

Some of the teachers have qualified in the four-year first degree course (B.A./B.Sc./B.Com.) after passing matriculation examination, while others have qualified in the three-year first degree course after passing higher secondary or PUC examinations, and while still others have qualified in the first degree after passing matriculation and honours in modern Indian language (Hindi/Urdu/Punjabi)

*In Delhi, quite a few schools have tented accommodation for some classes and some have improvised school buildings. Hence the nature of a school building is one of the important factors to determine the status.

and/or oriental language (Sanskrit/Persian/Arabic) examinations. Quantification scheme of academic qualifications starting from the first degree, as followed in this study, is as under:

	I Div.	*II Div.*	*III Div.*
B.A./B.Sc./B.Com. or equivalent	3	2	1
M.A./M.Sc./M. Com. or equivalent	6	5	4

Based on this scheme, a teacher obtaining first division in B.A. and second division in M.A. gets 3+5=8 scores, while a teacher securing second division both in B.A. and M.A. gets 2+5=7 scores. Similarly, other combinations have been formed to arrive at a single score for each teacher.

As regards quantification of professional qualifications of teachers, the following scheme has been adopted:

	I Div.	*II Div.*	*III Div.*
B.Ed./B.T./LT. Theory	3	2	1
Practical	3	2	1
Total	6	4	2

The untrained teachers have been given 0 score.

The total scores (k) for academic and professional qualifications of all teachers working in a school have been divided by the number of teachers (t) to get the index *average qualifications of a teacher* in that school, i.e. $\frac{k}{t}$.

Average teaching experience of a teacher in a school has been calculated by adding the teaching experience of all teachers (expressed in terms of approximate years) working in that school and then dividing the value (n) thus obtained by the number of teachers (t), i.e. $\frac{n}{t}$

Average cost per pupil has been calculated by dividing the total recurring expenditure of a school (q) during the last three years by the total number of pupils in that school in these three years (E), i.e. $\frac{q}{E}$

Index of educational efficiency ($\bar{x}$) as defined in terms of pupils' performance (pass %) in the external examination has been

calculated on the basis of higher secondary examination results of each sampled school for the examination years 1969 and 1970, as under:

$$\bar{x} = 100\left(\frac{M_1 + M_2}{N_1 + N_2}\right)$$

Where M_1 and M_2 are the number of pupils who passed the higher secondary examination in 1969 and 1970 and N_1 and N_2 are the number of pupils who appeared in that examination in those two years.

Adjusted educational efficiency ($\bar{x}$) *in relation to average class size* and average qualification of a teacher for schools A and B.*

Suppose the maximum average class size based on data received from all the 21 schools works out to 40 pupils and average class size of school A is 30 and of school B 40. Suppose again, the maximum average qualification of a teacher based on data received from all the 21 schools works out to 12 and average qualification of a teacher for school A is 10 and for school B 8. Suppose further that the average pass percentage based on the higher secondary examination results of 1969 and 1970 in both the schools is 60. The adjusted educational efficiency ($\bar{x}$) for schools A and B in relation to these two variables will be as follows:

$$\bar{x}_a = 60 \times \frac{30}{40} \times \frac{12}{10} = 54\%$$

$$\bar{x}_b = 60 \times \frac{40}{40} \times \frac{12}{8} = 90\ \%$$

The adjusted index of efficiency for each sampled school according to the above model was constructed. This was followed by working out co-efficients of correlation (r) between the five variables viz. school size and costs per pupil, school size and educational efficiency (actual), school size and educational efficiency (adjusted), costs per pupil and educational efficiency (actual) and costs per pupil and

*Average class size appears to be negatively correlated while average qualification of a teacher is likely to be positively correlated with educational efficiency.

educational efficiency (adjusted). The significance of correlations was also tested statistically.

Partial correlations were calculated between school size and per pupil costs with efficiency (both actual and adjusted) held constant; between school size and efficiency with per pupil costs held constant; and between school efficiency and costs with school size held constant.

The 21 sampled schools were divided into three groups according to their size namely, small-sized (enrolment below 500), medium-sized (enrolment 500-750) and large-sized (enrolment above 750). Analysis of variance was carried out to find out if the means of costs per pupil, educational efficiency (actual) and educational efficiency (adjusted) differed significantly or not for these groups.

III

Analysis of Data

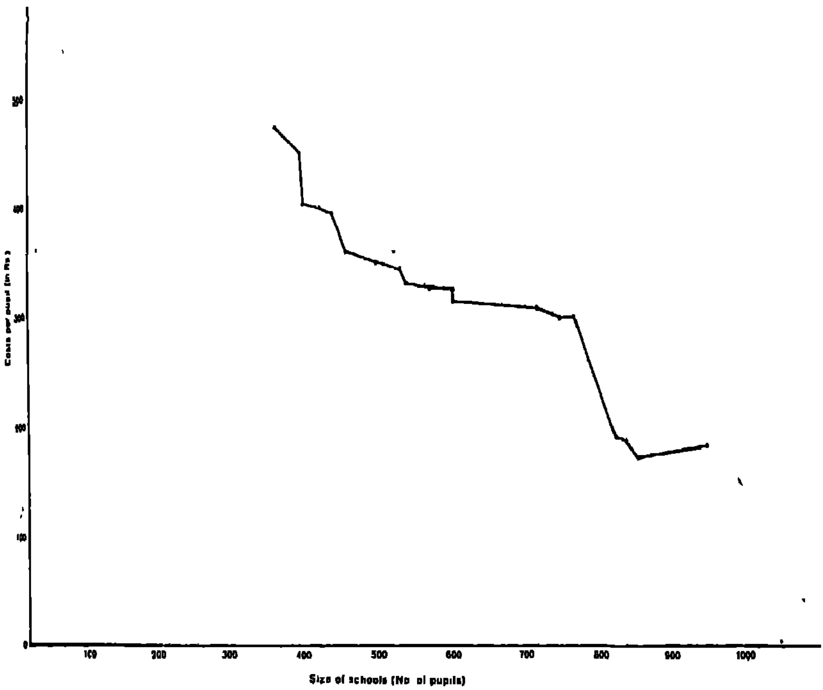
1. *Relationship between School Size and Costs*

The correlation co-efficient between the size of school and the costs per pupil was found to be as high as — 0.94. This shows that there is a close negative relationship between these two variables. The high correlation co-efficient size affirms the hypothesis that the per pupil cost decreases with increase in the enrolment. The partial correlations between school size and per pupil costs, when actual and adjusted efficiency are held constant, reduce to — 0.91 and — 0.84 respectively. This shows that the relationship between these two variables is not much changed with the variation in efficiency of schools.

The costs per pupil for different sizes of schools are depicted in the graph below. It will be seen from the graph that the drop in per pupil costs is relatively small when the number of pupils increases to 70.5. On the other hand, the schools having enrolment between 750 and 850 have distinctly lower per pupil costs compared to smaller schools.

2. *Relationship between School Size and Efficiency*

The co-efficients of correlation between the size of school and



the actual and adjusted efficiencies were found to be 0.29 and 0.32 respectively. Both these values are not significant. These rather weak relationships show that the efficiency of a school whether actual or adjusted in relation to certain school factors, depends not only on the size of school, but also on many other factors, such as intelligence of pupils, their scholastic aptitude and their socio-economic background, effectiveness of management, teachers' enthusiasm, teachers' competence in subject-matter, etc. The partial correlations between school size and actual and adjusted efficiencies, when the variable per pupil costs is held constant, reduce to .024 and 0.59 respectively. This shows that when the effect of per pupil costs is removed, the relationship between school size and efficiency becomes all the more insignificant.

3. *Relationship between School Efficiency and Costs*

The correlation co-efficients between the costs per pupil and school efficiency (actual and adjusted) were found to be —0 30 and —0.32 respectively. Both these values are insignificant. It is interesting to note that consistent with the results obtained for relationship between school size and efficiency, the relationship between school efficiency and costs is also not very strong. This means that school efficiency depends upon many more factors, besides the costs per pupil and the size of school. The partial correlations between actual and adjusted efficiencies of schools and per pupil costs, when school size is held constant, reduce to—.071 and —0.059 respectively. This shows that when the effect of school size is partialled out, the relationship between school efficiency and costs becomes all the more insignificant.

4. *Comparison of Costs per Pupil and Educational Efficiency in Schools of Different Sizes*

The 21 sampled schools were divided into three groups according to their sizes. The 7 schools with enrolment below 500, 9 schools with enrolment between 500 and 750 and 5 schools with enrolment above 750, were considered respectively as small-sized, medium-sized and large-sized schools. Costs per pupil and educational efficiency (actual and adjusted) were compared for these three groups of schools by using analysis of variance. The results are summarised in Tables 6-8 below:

TABLE 6

Analysis of Variance for Comparison of Costs per Pupil in Schools of Different Sizes

Source of Variation	*d.f.*	*Sums of Squares*	*Mean Square (Variance)*	*F*
Between groups	2	111489	55744	36††
Within groups	18	28038	1558	
Total	20	139527		

$$F = \frac{55744}{5581} = 36$$

The value of F is significant at .01 level.

TABLE 7

Analysis of Variance for Comparison of Educational Efficiency (Actual) of Schools of Different Sizes

Source of Variation	*d.f.*	*Sums of Squares*	*Mean Square (Variance)*	*F*
Between groups	2	399.14	199.57	<1
Within groups	18	4482.45	249.02	
Total	20	4881.59		

$$F = \frac{199.57}{249.02} = <1$$

The value of F is not significant.

TABLE 8

Analysis of Variance for Comparison of Educational Efficiency (Adjusted) of Schools of Different Sizes

ource of Variation	*d.f.*	*Sums of Squares*	*Mean Square (Variance)*	*F*
Between groups	2	345.50	172.75	1,12
Within groups	18	2752.78	152.93	
Total	20	3098.28		

$$F = \frac{172.75}{152.93} = 1.12$$

The value of F is not significant.

It will be seen that the means of per pupil costs in the three groups of schools differ significantly, while the means of educational efficiency (both actual and adjusted) are not significantly different. These results are in conformity with the results obtained through correlation co-efficients.

IV

Findings and Conclusions

1. There is a high correlation between the size of school and the costs per pupil.

2. Considering the economic criterion, the size of a higher secondary school with classes VI-XI should be between 750 and 850.

3. Although there is a small positive correlation between school size and efficiency and a small negative correlation between school efficiency and per pupil costs, the relationships are not significant. It is perhaps due to our sample being small and also due to the fact that efficiency depends on many more factors, e.g., intelligence of pupils, their scholastic aptitude and their socio-economic background, etc.

V

Limitation of the Study

The limitation of the study is that the sample is small and possibly biased due to high degree of non-response. However, the bias is not expected to be serious. The above conclusions are subject to this limitation and, therefore, are only suggestive of the type of relationship to be expected between school size, per pupil costs and efficiency as measured by pass percentage in the external examination.

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Stability of the Self-Concept

Pratibha Deo

In measuring the self-concept, many studies show low stability, i.e., a low test-retest reliability which Cronbach has called the "coefficient of stability". This study on one hundred B.Ed students in a Punjab college had four sessions as test administration at time intervals of a month, a month-and-a half and two months after the first administration. Consistency and discrepancy scores were developed. There is a trend of systematic decrease of consistency scores as the time interval increases. Though total scores tend to remain stable, there are changes within the scores. Means of discrepancy scores increase steadily with time interval. These differences are significant. It appears that the fluid self-concept and personal variability rather than unreliability of measuring instrument are responsible for the variations.

Amongst the different methods used for establishing reliability, the test-retest method aims at getting the error variance due to random fluctuations in the performance from one test session to another. Cronbach (1947) has proposed the term "Coefficient of stability" to this test-retest measure, since the attempt is to find out how stable the scores would be from one session to another.

Researchers have shown considerable interest in personal variability in measured abilities. According to Guilford (1954), it was pointed out that we should know not only the examinee's characteristic level on a scale of ability but also his degree of consistency in performing near that level. Mosier's epsilon score (Guilford 1954) i.e. the degree of variability showed a low reliability of only .55 and that by Lorr was .64 (Guilford 1954). Glaser (Guilford 1954) measured consistency by administering the test two or three times, but the reported reliabilities ranged only from .51 to .72. On the basis of these results Guilford (1954) concluded that no consistency score yet proposed has achieved sufficient reliability or generality.

In most of the reported reliability coefficients in ability tests, the phenomenon of intra-individual changes does not pose a serious problem, because over not-too-long a period of retesting, the responses of the individuals tend to be uniform and patterns of responses remain more or less the same. However, this may not hold true in case of certain personality measures like self-concept which are more sensitive to small changes. In these cases daily experiences are likely to cause shifts in responses. This is the reason why researchers in self-concept are first concerned with the reliability of self-concept scores.

Wylie (1961) has observed that in the majority of studies on self-concept, no reliability estimates are given and those that are presented are mostly of the split-half or inter-judge variety, giving no indication of stability on retest. However these two methods of reliability present different pictures of error variance. It has been remarked appropriately by Wylie (1961) "Regardless of which basis is used for constructing and interpreting the split-half coefficients which may be obtained from the long lists of items, all workers agree on *a priori* grounds that such coefficients will overestimate the total reliability of a test over time, since the total unreliability includes the instability error as well as the inconsistency error". Dudeck (1952) has demonstrated empirically that this is the case under specified conditions of test lengths and difficulty. Gulliksen (1950) has cited several studies appearing before 1950 which also demonstrated empirically that correlated odd-even coefficients overestimate

both test-retest and parallel form correlations. Such overestimation in the opinion of Wylie (1961) is due to the fact that the split-half coefficient is free of errors associated with time. In some instances, the split-half coefficient may be larger than the coefficient of stability because of the spurious effect of response sets which might be particularly influential at one testing session. The coefficient of stability, therefore, is the only appropriate estimate when testing self-concept-time relationship. Cureton (1958) had contended that the error variance should be uncorrelated with true score if the coefficient is to be interpreted as a reliability coefficient for the combination of factors we are attempting to measure. Wylie (1961), nevertheless, has suggested that it is unlikely that error variance is uncorrelated when one obtains a coefficient from two repetitions of the same test.

In spite of this basic importance of studying stability of self-concept measures, very few studies are available in this field as has already been observed by Wylie (1961). Studying the reliability of the self-ideal 'r's, it was noted that the control group of subjects who did not have counselling showed a mean initial self-ideal 'r' of .58 as compared to a mean follow-up 'r' of .59 (Wylie 1961). Using two hundred anonymous self-descriptions by adults, Taylor (1955) observed one week test-retest mean 'r' of .79 for self-ideal sorts. The eight-week test-retest reliability coefficients for Bill's Self, Ideal and Other Person are .79, .72 and .78 respectively. In a study by Engel (1959) the average self-self correlations over a ten day period was .68 and by comparison, the average self-self 'r' over a two year period was .53; this confirmed the author's hypothesis that crystallization of the self-concept is achieved earlier in development.

This shows that adequate evidence on the stability of self-concept scores is lacking. Moreover, it seems that the concepts of stability have not been further tested on the concepts of consistency, because most of the studies are satisfied with calculations for total scores. However, such a method of studying consistency only with the difference between the total scores on two administrations hardly gives a correct and complete picture of shifts in the responses, because theoretically, the whole score may remain almost the same

yielding a very high correlation and yet there may be a considerable shift in responses if studied itemwise. While studying the total scores-difference and item-to-item discrepancy, the author (Deo 1968) observed a correlation of only .484 between these two sets of differences which suggested that the itemwise consistency is somewhat different from the total scores correspondence and that item-to-item discrepancy is a more accurate way of studying shifts in responses. Since no studies are available from any other sources to the best of the author's knowledge, the present investigation was undertaken to study the stability, consistency and discrepancy of self-concept scores obtained by test-retest method on repeated administrations. The total scores correspondence can be called stability, item-to-item one, consistency, and item-to-item changes in responses can be termed discrepancy. The aim of this investigation is to trace the trend of changes in these three types of scores over time, and thus to study stability and consistency of self-concept scores.

Method and Procedure

Tools used—The adjective check-list method for obtaining self-concept measures has been used. For this the author's PWL (Deo's Personality Word List) was administered. The test-retest reliability coefficient for whole scores for the PWL has been reported to be .89 and the convergent and discriminant validity for this has been established (Deo and Singh 1971).

Sample—Initially a sample of one hundred B.Ed., students from a training college in Punjab was chosen. The PWL was administered to them four times during the session. However, for the final sample, only those cases were retained who were present on all the four occasions. The effective final sample thus came to 50.

Administration and scoring—The PWL was administered to the B.Ed., class in four sessions, the time gaps being a month, half-a-month and two months. The logical sequence of the ascending order of time gaps could not strictly be followed because of the intervening vacations. Every effort was made to keep the other environmental factors the same. Thus, on the basis of these four administrations,

the time intervals for study which were available were half-a-month, a month, a month and a half, two months, two and half months and three and half months. The four sessions were marked as A, B, C, D in the order in which they were given.

The total words marked on one occasion gave the total score with the name of that session. Thus the four total scores were termed A, B, C and D. An item marked in one session but not in the other one was counted as one discrepancy for the individual for those two sessions. The total of all such discrepancy scores for the individual yielded his total discrepancy score, D. The consistency score, was worked out by the formula

$$C = \frac{X + Y - D}{2}$$

where C is the consistency score, X and Y are the total scores on the two occasions and D is the discrepancy score between these two occasions. This consistency score came out to be exactly the same as the item-to-item consistency which could be calculated as follows: an item marked on both the occasions is counted as one consistency score for the individual and the total of all such scores gives that individual's total consistency score for those two occasions.

Analysis of data—Once the Total scores. Consistency scores and Discrepancy scores were obtained for all the individuals, their means, standard deviations, and standard errors of means and of standard deviations were calculated. The product-moment correlations between the different sets of scores were also obtained. For getting the significance of difference between means of scores, the single group method for the correlated means (Garrett 1958) was used and the t-ratios were accordingly calculated.

Results

The means, standard deviations, and the standard errors of means and of standard deviations for the four sets of Total scores A, B, C and D are presented in Table 1

Table 2 shows the correlations and the t-ratios with the levels of significance for the Total scores A, B, C and D.

TABLE 1

Means, Standard Deviations, and Standard Errors of Means and SD_S for the Total scores obtained on four sessions

Total Scores	*M*	*SD*	SE_M	SE_{SD}
A	75.86	19.82	2.80	1.98
B	78.38	16.71	2.36	1.67
C	79.60	19.64	2.78	1.96
D	78.62	16.34	2.31	1.63

TABLE 2

Product-moment correlations and the t-ratios between Total scores on four sessions with levels of significance

Total Scores	*B*	*C*	*D*
A	r= .816 t=1.58 NS	r= .691 t=1.05 NS	r= .683 t=1.32 NS
B		r= .868 t=0.82 NS	r= .786 t=0.16 NS
C			r= .787 t=0.51 NS

The means, standard deviations and standard errors of means and of standard deviations for the Consistency scores obtained for the six time-intervals are depicted in Table 3.

The correlations and the t-ratios with the levels of significance for the Consistency scores for the six time-intervals are given in Table 4.

In Table 5 are reflected the means and standard deviations with their standard errors for the Discrepancy scores obtained on the six time-intervals.

TABLE 3

ıd Standard errors of Means and SD_s for
ıbtained on six time—intervals

M	SD	SE_M	SE_{SD}
).16	17.84	2.52	1.78
5.14	17.75	2.51	1.77
4.92	18.79	2.66	1.88
5.00	17.97	2.54	1.80
3.00	16.32	2.31	1.63
0.20	17.34	2.45	1.73

TABLE 4

d the t-ratios between Consistency Scores
.th levels of significance

) no)	OD (2 mo)	BD (2½ mo)	AD (3½ mo)
930 33 1 lev	r= .924 t=3.28 sign. .01 lev	r= .790 t=3.90 sig. .01 lev	r= .833 t=6.18 sig. .01 lev
.937 .24 ;	r= .784 t=0.45 NS	r=0.749 t=1.25 NS	r= .927 t=5.31 sig. .01 lev
	r= .881 t=0.77 NS	r= .776 t=1.14 NS	r= .927 t=4.82 sig. .01 lev
		r= .878 t=2.40 sig. .05 lev	r= .882 t=4.63 sig. .01 lev
			r= .834 t=2.01 sign. .05 lev

TABLE 5

Means, Standard Deviations and Standard Errors of Means and SD_s for the Discrepancy Scores obtained on six time—intervals

Discrepancy Scores	*M*	*SD*	SE_M	SE_{SD}
BC (½ mo)	10.24	7.22	1.02	0.72
AB (1 mo)	23.96	6.28	0.89	0.63
AC (1½ mo)	25.04	9.33	1.32	0.93
CD (2 mo)	26.32	8.47	1.99	0.85
BD (2½ mo)	29.00	7.59	1.07	0.76
AD (3½ mo)	34.08	9.32	1.32	0.93

TABLE 6

Product-moment correlations and the t-ratios between Discrepancy Scores for six time intervals with levels of significance

Discrepancy Scores	*AB* (*1 mo*)	*AC* (*1½ mo*)	*CD* (*2 mo*)	*BD* (*2½ mo*)	*AD* (*3½ mo*)
BC (½ mo)	r= .530 t=5.02 sig. .01 lev	r= .733 t=7.44 sig. .01 lev	r= .486 t=6.27 sig. .01 lev	r= .550 t=9.86 sig. .01 lev	r= .590 t=13.61 sig. .01 lev
AB (1 mo)		r= .696 t=2.08 sig. .05 lev	r =.319 t=1.89 NS	r= .367 t=4.54 sig. .01 lev	r= .657 t=10.12 sig. .01 lev
AC (1½ mo)			r= .574 t=0.32 NS	r= .620 t=2.86 sig. .01 lev	r= .771 t=9.04 sig. .01 lev
CD (2 mo)				r= .913 t=5.36 sig. .01 lev	r= .638 t=7.19 sig. .01 lev
BD (2½ mo)					r= .725 t=5.58 sig. .01 lev

Table 6 gives the correlations and the t-ratios with their levels of significance for the six sets of Discrepancy Scores.

Correlation between the Discrepancy Scores and the Consistency Scores for the six time intervals were calculated. These are shown in Table 7.

TABLE 7

Product-moment correlations between the Discrepancy Scores and Consistency Scores obtained on six time-intervals

Consistency Scores	BC (½ mo)	AB (1 mo)	AC (1½ mo)	CD (2 mo)	BD (2½ mo)	AD (3½ mo)
BC (½ mo)	—.136	—.077	—.171	—.181	—.198	—.163
AB (1 mo)	.049	—.222	—.151	—.087	—.060	—.123
AC (1½ mo)	—.134	—.198	—.302	—.212	—.225	—.230
CD (2 mo)	—.035	—.046	—.155	—.339	—.347	—.211
BD (2½ mo)	.032	—.059	—.140	—.371	—.377	—.203
AD (3½ mo)	.019	—.225	—.225	—.238	—.249	—.290

An attempt was made to find out if the Discrepancy Scores and the Consistency Scores showed a correspondence with the Total Scores from where these two sets of scores were obtained. This was done by obtaining the correlations for one set of Discrepancy and Consistency Scores with the two sets of Total Scores which yielded the Discrepancy and the Consistency Scores. These calculations are presented in Table 8.

TABLE 8

Product-moment correlations of the Consistency Scores and the Discrepancy Scores with their respective Total Scores

	A	*B*	*C*	*D*
BC Cons.	—	.922	.968	—
Disc.	—	.153	—.028	—
(½ mo)				
AB Cons.	.954	.914	—	—
Disc.	—.093	.022	—	—
(1 mo)				
AC Cons.	.890	—	.893	—
Disc.	—.056	—	—.062	—
(1½ mo)				
CD Cons.	—	—	.928	.909
Disc.	—	—	—.103	—.108
(2 mo)				
BD Cons.	—	.783	—	.834
Disc.	—	.014	—	—.125
AD Cons.	.893	—	—	.874
Disc.	.002	—	—	—.048
(3½ mo)				

To trace the changes in these three types of scores, graphical presentations was made for the Total as well as for the Discrepancy and the Consistency Scores. These are shown in Fig. 1.

Discussion

It can be seen from Table 1 that there are slight changes in the means and standard deviations of Total Scores over the time under study. Standard errors of means and of Standard Deviations also do not show large fluctuations. These suggest a good stability of

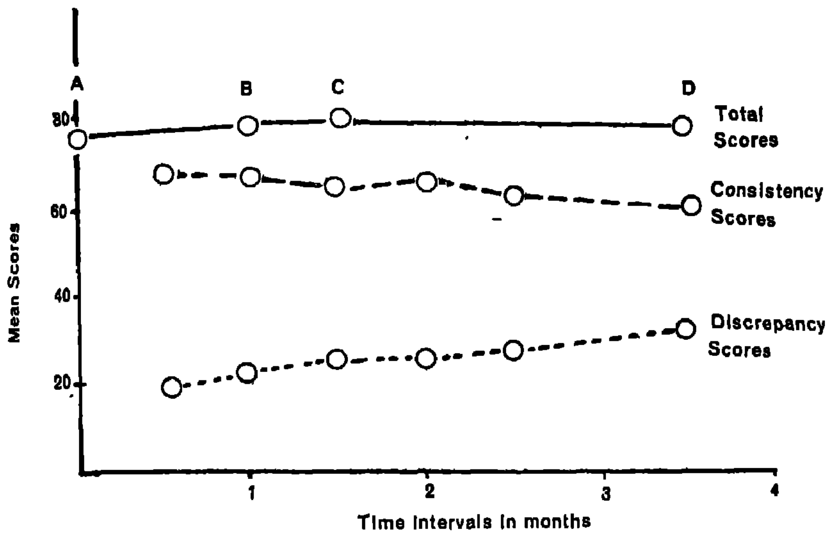

Fig. 1
Changes in Self Concept over time

total scores. To find out if the differences between means are significant or not, the t-ratios were calculated which are given in Table 2. Not a single t-ratio is observed to be significant even at .05 level, thereby suggesting that there are no genuine differences between means of Total Scores, this supports the finding of good stability of Total Scores over the period of three and half months. Looking at the correlations, the 'r's range between .683 and .868 yielding considerably high reliability coefficients for the Total Scores. The highest correlations of .868 and .816 are for the time-intervals of half-a-month and a month respectively. All the 'r's are sufficiently high and therefore, it can be concluded on the basis of 'r's and the t-ratios that the four sets of Total Scores exhibit a good degree of stability. These results present a far better picture than the one reported by Phillips (1951) who observed a correlation of .84 over five days interval, because in the present study, much longer time-intervals give high correlations.

Table 3 giving the means and SD's for the Consistency Scores show the trend of a systematic decrease in means of Consistency

Scores as the time intervals increase except for the interval of CD. The Standard deviations remain more or less the same and no wide fluctuations are observed in their Standard errors. Combining the results of this table and those presented in Table 4, it can be noted that all the correlations between the Consistency Scores for different time-intervals are very high, ranging between .749 and .937. These 'r's are much higher than the ones reported in the other studies mentioned. However, the t-ratios present a slightly different picture; out of the 15 differences between the means of Consistency Scores, 8 differences are significant at .01 level, 2 at .05 level and 5 differences are not significant at all. The differences which are not significant are between one month interval, on the one hand and one and a half months, two months and 2½ months intervals on the other hand and between one and a half months with two and half months intervals. The interesting fact is that the two extreme intervals of half a month and three months and a half show significant differences with all the other time intervals. This indicates that though the Total Scores remain stable, there are changes within the scores which disturb the consistency of responses.

From Tables 5 and 6 can be seen some interesting trends in the Discrepancy Scores. The means of Discrepancy Scores gradually and steadily increase as the time intervals increase, the smallest time interval having the smallest mean and the largest time-interval, the largest mean. The Standard deviations show some changes which are not wide. The Standard errors of both M's and SD's are quite small. Looking to the t-ratios from Table 6, 12 out of 15 differences between means are significant at .01 level and one is significant at .05 level. Only two differences are not significant and these are between two months interval on the one hand, and one month and one and half months on the other hand. This phenomenon is very important to be noted, because though the Total Scores have exhibited good stability, changes in word-to-word discrepancies are significant. However, it seems that the Discrepancy Scores change while the Consistency Scores show only slight shifts and the Total Scores remain more stable. This phenomenon of slight changes in Consistency Scores and more fluctuations in Discrepancy Scores suggests the probability that the self-concept consists of two major parts, one is a crystallized self-concept which remains more or less

the same over a long period and the other one is a fluid self-concept which is very sensitive and susceptible to change in the environment. The formation of the self-concept is around a crystallized nucleus in which the individual has some firm notions about his self and these rarely undergo change. This is surrounded by the fluid self-concept, that is, those concepts of his characteristics about which the individual is not certain and in which he can show considerable shifts. Further investigation will be needed to study analytically this hypothesis.

Since it appears that the fluid self-concept contributes to the discrepancies, the not-very-high correlations between scores with a gap of long time-intervals can be attributed to the personal variability and not to the unreliability of the measuring instrument. This is supported by the fact that the increase in discrepancy is directly proportional to the length of the time-interval.

The correlations between the Consistency Scores and the Discrepancy Scores over different time-intervals have been shown in Table 7 and judging from the size of the correlations ranging from —.377 to .049, it can be said that all these correlations are mostly low and of moderate size. All 'r's except one between Consistency (1 month) and Discrepancy (½ month) are negative point out to the trend that the Consistency Scores and Discrepancy Scores are negatively correlated. The higher are the Discrepancy Scores, lower are the Consistency Scores and vice versa, a fact which is very significant. The only 'r' which is positive is very low and that indicates almost no relationship. These results indicate the individual differences. There seem to be some subjects for whom the Consistency Score is high and Discrepancy Score is low, that is, these people have a more firm concept of their self-steady self people. Some subjects are with low consistency scores and high discrepancy scores, the unsteady self type of people.

Interesting inferences can be drawn from the results given in Table 8 where the correlations for the Consistency and Discrepancy Scores with the two sets of scores from where they are derived are given. All the Consistency Scores indicate high correlations with their parent Total Scores ranging between .783 and .968. This suggests that higher the Total Scores, higher are the Consistency Scores and vice-versa. The highest correlations are observed between Con-

sistency for BC (½ month) and Total B and C Scores, as also for AB (1 month) and CD (2 months) Consistency Scores. The correlations of Discrepancy Scores with the two sets of parent Total Scores range between —.125 to +.153. It can be inferred that these correlations are of very low size, sometimes negative, and sometimes positive but giving a very low relationship. It seems that the Discrepancy Scores do not bear any high or even a moderate relationship with the parent Total Scores which correlate highly with their consistency scores.

Fig. 1 also clarifies the trend of the changes in these three types of scores. A fairly constant line parallel to X-axis indicates good stability of Total Scores. Discrepancy Scores show a gradual increase with time and the Consistency Scores show a slight decline with time. At the same time, these curves do not show wide fluctuations or any steep rise or fall. On the other hand the smooth and gradual changes indicate a fair continuity and stability in the self-concepts over the period under study.

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Sociometric Structure of the Pre-Adolescent Classrooms and the Personality Differences Among High-Choice Receiving and Low-Choice Receiving Children

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Sociometric structure of V grade classrooms of 44 Delhi schools and personality differences between stars and isolates have been studied by the authors. In about 55% schools there is no overchosen student and in most of the rest there is one each. Only in 4% are there more than 2 overchosen students. The number of isolates varies from 0 to 25. In about 10% schools isolates amount to more than 50%, and in 59% they are nearabout one-quarter the class strength. There is thus poor integration and poor cohesiveness in these classrooms. While the scores are not significant, the stars and the overchosen tend to have better personality. Stars do not, however, differ much from isolates in their adjustment towards friends. Sex differences have been studied and found negligible.

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The recently published survey of "Research in Psychology in India" by Mitra (1972) on behalf of the Indian Council of Social Sciences Research reveals that there are rather very few studies conducted in India on the inter-personal processes of students. These few studies which have been briefly referred in the research reviews on educational psychology (Buch, 1972) and Social Psychology (Rath, 1972) appears to be mainly on the adolescent boys and were conducted prior to 1969. A few more studies that appeared after 1969 have also concentrated on the adolescent boys and girls (Mohan and Mohan, 1969, 1970; Kalanidhi, 1971; Malhotra, 1971 and Singh, 1971). These studies took a new direction in the sociometric studies in terms of studying the effects of leadership training (Mohan and Mohan, 1969), examination results (Mohan and Mohan, 1970; Kalanidhi, 1971) and excursion (Singh, 1971), etc. on the sociometric choices. Studies relating the personality to sociometric choices are rare and perhaps nil on pre-adolescents. Social preferences being an important aspect of the classroom-dynamics, the present study was undertaken as a part of the Indian Council of Medical Research project on 'Motivation Training for Mental Health' with following objectives:

1. To study the sociometric structure of fifth grade classrooms of Delhi schools; and
2. To study the personality differences between stars and isolates.

Sample: A total of 1426 fifth grade students from the fifth grade classes of 44 Delhi schools participated in this study. These schools were governed by the Delhi Municipal Committee and Delhi Municipal Corporation and were catering to students of similar cultural and socio-economic background.

Methodology

To study the sociometric structure of these classrooms each of the students from these classrooms was asked to name three of his best friends from his class in rank order. After collecting the data, sociograms for each class were prepared and the number of choices as well as the percentage of choices received by each student were

prepared. From these data the following sociometric indices were prepared:

1. *Overchosen*: Any student in a class getting 25% or more of the first choices was considered as overchosen (This criterion was fixed purely to get extremely preferred students and by this criterion any class-room can contain not more than 4 overchosen). Another criterion used is given below.
2. *Stars*: Students from each class receiving the highest number of choices.
3. *Isolates*: Any student who has not received any kind of choice from any other student of the class.
4. *Class Integration*: This index was aimed to find the class-room integration in terms of the sociometric choices.

$$\text{Class integration Index} = \frac{100\ (\text{No. of isolates} + \text{No. of overchosen})}{\text{Total No. of students in class}}$$

5. *Class Cohesiveness*: The numbers of mutual choices in each of the classes were calculated and class cohesiveness index was obtained for each class by the formula

$$\text{Class cohesiveness index} = \frac{100 \times \text{total No. of mutual choices of the class}}{\text{Total No. of mutual choices possible in that class.}}$$

6. *Sociometric Index*: Sociometric index of each student is given by [3 × (total number of first choices received) + 2 × (total no. of second choices received) + (total number of third choices receive], divided by (the total number of students in the class making choices—1).

Besides the definition given above, in another case, all those students getting a sociometric index of 1.00 or above were treated as overchosen. However, this criterion was used only while comparing the personality variable scores of overchosen and isolates.

The following variables were chosen to study the personality differences between high choice receiving and low choice receiving

children : Adjustment towards home, school, teachers, peers, general matters and overall adjustment; intelligence, classroom trust level of the student; initiative and activity levels of the students. Pre-adolescent adjustment scale (PAAS), pre-adolescent class-trust scale (PACTS) and pre-adolescent initiative questionnaire (PAIQ and PAALS) developed by Pareek and associates (1970, 1971) were used to measure adjustment, class trust, initiative and activity levels of students. Group intelligence test in Hindi developed by Mehta (1962) was used to measure the intelligence of these students.

To describe these instruments briefly, PAAS is a 40—itemed scale measuring the pre-adolescents' adjustment towards home, school, teachers, peers, general matters and giving 5 sub-scores and a total score. Scores on adjustment towards home may range from —10 to +10, and the scores on school, teacher, and peer adjustment may range from —10 to +6 in each, general adjustment score may range from —6 to +6 and the total score from —46 to +34. Negative scores indicate maladjustment and positive scores indicate adjustment to the extent indicated by the magnitude of the score. PACTS is a 8-item semi-projective inventory with a 4-point scale and the scores may range from 8 to 32, high scores indicating high level of trust by the respondent. PAIQ is a 6-item open-ended and semi-projective test and scores can range from 0 to 18 with high scores indication high initiative levels of the students. PAALS is a 9-point rating scale meant for the teachers, to be rated by teachers giving a score of 9 to highly active students. A detailed description of these tests and the operational definitions of the variables are presented elsewhere (Pareek, *et. al.*, 1970 and Pareek and Rao, 1971).

Data Analysis

For describing the sociometric structure of the classrooms the number of isolates, and overchosen in each of the classrooms are presented. Critical ratios were worked out between the high choice receiving group and no choice receiving group on each of the personality variables mentioned above. Sex differences were studied by using critical ratios between the personality variable scores of male and female stars as well as between male and female isolates.

Results

Sociometric Level and Classroom Structure of the Pre-Adolescents of Vth Grade Classrooms in Delhi

Overchosen: To see the sociometric patterns of the classrooms the number of overchosen students in each class, as well as the number of isolates were counted. If a class has four overchosen pupil by the definition of overchosen it means that the classroom structure is not very much integrated and is biased towards a few. Number of overchosen pupil in each class is given in column 3 of Table 1. Column 2 of the same Table also gives the number of students making choices or taking this test. As evident from the Table in 24 schools, i.e., about 55% of the schools there were no overchosen showing that distribution of first choices were not highly concentrated towards a few pupil. In 18 schools or in about 41% of the schools there is one over-chosen in each showing the concentration of first choices on one individual in these class-rooms; and in only 4% of the schools they are concentrated over two individuals and in none the over-chosen are more than two.

Isolates

The number of isolates is given in column 4 of Table 1. The number of isolates in these classes varies from 0 to 25. There is only one school which does not have any isolates. In about 10% of the schools the number of isolates is about 50% of the class strength. This shows that in at least 10% of the schools half of the students remain isolated from peers. This is quite disturbing. In about 59% of the schools the number of isolates is near about ¼th of the strength of the class or more.

Class Integration

As the formula used indicates, class integration index is nothing but the percentage of isolates and overchosen (combind) in a class. Higher the index or percentages, higher the concentration of choices and less the integration of the class. The integration index

for each class is given in column 5 of Table 1. In one class there were no isolates and no overchosen indicating a high integration. In another class the percentage of isolates and stars is 8.0 (the minimum among the rest) and in the rest of the classes it is above 10.0 with about 5 schools having more than 50% stars and isolates. This indicates a rather poor integration in these classrooms.

Class Cohesiveness

Class cohesiveness indices of all the classes are given in column 6 of Table 1.

As seen in Table 1, the highest cohesiveness exists in only one class where about 10% of the total no. of possible mutual choices have been made. In about 5 schools (11% of the sample) the total number of mutual choices exceed 5%. In 4 schools (or in about 9%) of the sample studied the percentage of mutual choices made is even less than 1. In general the observations from Table 1 suggest that the cohesiveness of the pre-adolescent class-rooms in Delhi is very poor, and there seem to be a number of net-works working in these classes and choices are not distributed equally to all students in the class-room, some times leaving as many as 50% of students isolated. However this generalization has two limitations; one of not having any comparable norms available in India giving the cohesiveness and integration indices of pre-adolescent classrooms; and second, the limitation intrinsically in the sociometric scale used here which measured only the first three preferences and not the rest, nor the dislikes.

Personality differences Between Stars and Isolates

To see whether those who are receiving many choices differ from those who are receiving no choices critical ratios were calculated between the scores of these two groups of pupils on different tests. For the purpose of these comparisons those whose sociometric index is above 1.00 were considered as overchosen and stars were mixed with these overchosen even when their sociometric index was not above 1.00 (as happened in a few cases). Those who received no choices were treated as isolates. The mean scores of each of these groups

TABLE 1

Number of overchosen and Isolates, Class cohesiveness and Intergration indices of the Vth grade classes of Delhi, as revealed by Sociometric Test (N=1426)

School No.	*No. of Students in the class Participating*	*No. of Overchosen*	*No. of Isolates*	*Class Integration Index*	*Class Cohesiveness Index*
1.	34	2	12	41.2	1.8
2.	43	0	10	23.3	2.0
3.	30	1	14	50.0	1.1
4.	40	1	15	40.0	1.2
5.	39	1	14	38.5	0.9
6.	30	1	7	20.5	0.9
7.	44	0	15	34.1	1.2
8.	32	1	13	43.7	1.6
9.	31	1	10	36.1	2.6
10.	40	0	8	20.0	1.9
11.	35	0	5	14.3	2.7
12.	25	1	4	20.0	4.7
13.	21	1	7	38.1	3.8
14.	25	0	2	8.0	5.3
15.	40	0	12	30.0	1.9
16.	24	0	3	12.0	9.7
17.	35	0	12	34.3	1.2
18.	31	0	6	19.3	1.9
19.	44	1	21	50.0	1.2
20.	39	1	21	56.4	1.0
21.	31	1	11	38.7	2.6
22.	33	1	18	57.6	0.8
23.	13	1	5	46.0	9.0
24.	20	1	5	30.0	4.7
25.	34	0	8	23.0	2.7
26.	47	0	25	53.2	0.8
27.	34	0	4	11.8	3.2
28.	19	0	2	10.5	6.4
29.	39	0	8	20.5	2.1
30.	46	0	11	23.9	1.8
31.	33	1	8	27.3	1.5
32.	26	0	0	0.0	5.2
33.	32	0	6	18.7	3.8
34.	37	0	5	13.5	1.9
35.	45	0	11	24.4	1.0
36.	20	0	3	15.0	4.2
37.	30	0	5	16.7	3.2
38.	31	0	2	6.5	4.3
39.	36	1	19	55.6	6.3
40.	26	0	10	38.5	3.4
41.	34	2	13	44.1	2.1
42.	42	0	10	23.8	1.6
43.	32	1	4	16.1	2.6
44.	35	1	11	34.3	2.0

TABLE 2

Mean scores and significance of the difference between mean scores of overchosen, stars and isolates on different tests

Test	*Mean score of the stars and overchosen* M_1	*Mean score of the Isolates* M_2	*S.D. of the scores of stars overchosen*	*S.D. of the scores of insolates*	M_1—M_2	*Critical ratio is significant at .05 level or not*	*No. of stars and over chosen*	*No. of Isolates*
Adj. to Home (PAAS)	7.29	6.71	2.67	3.17	0.58	No	96	325
Adj. to School (PAAS)	2.93	0.84	2.87	3.36	2.09	No	96	325
Adj. to Peers (PAAS)	2.93	2.14	2.74	3.46	0.79	No	96	325
Adj. to Teacher (PAAS)	3.46	2.10	2.57	3.17	1.36	No	96	325
Adj. General (PAAS)	4.01	3.19	2.10	2.45	0.82	No	96	325
Adj. Total (PAAS)	20.61	14.98	9.13	11.95	5.53	No.	96	325
Intelligence	30.87	26.33	7.68	7.81	4.54	No	100	360
Class Trust (PACTS)	23.57	21.76	3.01	3.43	1.81	No	95	338
Initiative (PAIQ)	12.47	9.47	5.13	4.33	3.00	No.	103	348
Activity level (PAALS)	7.19	4.52	2.08	2.78	2.67	No.	75	221

on different tests and the significance of the difference between the two group means for each variable are presented in Table 2.

A critical look at Table 2 reveals that though none of the differences are significant at .05 level there is a definite trend in all the tests supporting better personality of the stars and overchosen than the isolates. The stars and overchosen have shown better adjustment, more intelligence, more initiative, more trust and more activity level than the isolates.

Since this clearly showed a definite trend towards stars and overchosen inorder to have a sharper picture of the difference, 't' ratios were calculated between the scores of stars and isolates without the overchosen. Even among the stars, only those who are receiving 10 or more first choices in each class are chosen. From the same class the same number of isolates and stars matched for sex were chosen and 't' ratios for the significance of the difference between the means were calculated. Table 3 gives the same.

Table 3 throws more light on the difference between the stars and the isolates. Again, stars seem to have better adjustment towards home, towards school, towards teacher and in total. However, it is interesting to note that stars do not differ much from isolates on their adjustment towards friends in spite of the fact that stars are the liked ones and isolates are the rejected ones from the first few preferences. Stars also show better intelligence, more classroom trust and high activity level as compared to isolates.

Sex Differences in Personality variables of Stars and Isolates

To find out if there are any significant sex differences even among stars and among isolates, 't' ratios were calculated between female and male stars and also between male and female isolates on the above mentioned 10 variables. 't' ratio between male and female stars was significant at .05 level only in case of intelligence with male stars scoring about 10 points more than the female stars. Apart from this all the 't' ratios were insignificant both for isolates and for stars and there was no positive trend for or against any sex.

Summary and Implications

This study on 1426 fifth grade children from 44 Delhi schools

TABLE 3

Mean differences between stars and isolates on the personality variables and significance of the difference.

S. No.	Variable	Mean Score of Stars M_1	Mean score of Isolates M_2	M_1—M_2	Significance level
1.	Adj. to Home (PASS)	8.20	5.52	2.68	.05 level
2.	Adj. to School (PAAS)	3.80	—0.71	4.51	.01 level
3.	Adj. to Peers (PAAS)	2.70	1.41	1.29	not significant at .05 level
4.	Adj. to Teacher (PAAS)	4.70	1.52	3.18	.01 level
5.	Adj. General (PAAS)	4.06	3.17	0.89	Not significant at .05 level
6.	Total Adj.	23.53	11.52	12.01	.01 level
7.	Intelligence	33.35	26.94	6.41	.05 level
8.	Trust	24.17	21.37	3.80	Not significant at .05 level
9.	Initiative	11.58	7.94	3.64	,,
10.	Activity level	8.25	4.20	4.05	.01 level

indicated that the fifth grade pre-adolescents classrooms of Delhi are not much integrated and are poor in cohesiveness. This indicates to rather narrowed down preferences of the 9 to 11 year pre-adolescents. The comparison of high choice receiving and no choice receiving students revealed that students receiving more choices tend to have better personality structure than those receiving no choices.

In view of the high number of isolates in the classrooms and their tendency to have poor adjustment and low scores on other desirable traits, it is perhaps essential to concentrate thinking on reducing isolates in the classrooms. A question may be raised using circular hypothesis, whether the isolates score poor on personality tests because they are not highly preferred by others or is it that they are not preferred because of their poor personality. While answers to this require carefully designed experimental studies, the observation of this study that isolates do not have as much of good adjustment towards their class-fellows as the stars (although the difference is not statistically significant) indicates that the first of the above two questions may have an affirmative answer. If that is so, attempts to reduce the isolates and improve the class cohesiveness, integration and mental health should concentrate perhaps on iden-

tifying and isolating those characteristics which are responsible for making the child an isolate or less chosen in his class and then to help them improve those characteristics. Perhaps, an attempt on the part of the teacher to locate isolates and to give them special attention through verbal interaction may help them to be liked by others.

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Scaling of Marks for Diverse Standard of Examinations

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The median scaling method, used now for a number of years in the Gauhati University for scaling raw marks of examiners due to variation of the standard of their marking, is critically examined and considered inadequate for the purpose. The possibility of using the well-known percentile method is next considered and deemed not quite satisfactory for evaluating marks under the present system. The linear transformation of marks is then suggested as most suitable considering several advantages it has over other methods. Finally, a linear scaling table is worked out for the purpose of ensuring rapid work with mark-sheets by scalers and tabulators.

In order to iron out gross irregularities in marking essay-type examination scripts by a variable subjective standard, the Gauhati University introduced two very significant measures in the Matriculation Examination of 1963. By one measure, it was decided to let every examiner receive a statistically equivalent packet of unidentifiable scripts (randomization); and by another, the marks given by an examiner were adjusted to (scaling) it they deviated markedly from a common standard or norm defined as the average

of medians for a particular set of examiners. A report by the University (Taylor, 1963) shows that randomization involved on that occasion more than 35,000 examinees and nearly 45 per cent scripts from over 1200 examiners in 7 zones were subjected to scaling adjustments. The pass percentage (50.7) of the said examination reached a new height that year beating a much lower rate (38.2%) for the previous year—an outcome that has been claimed as due to the implementation of the above measures by the University.

Now, apart from the 'impressive' result obtained for a certain category of students, which may or may not be accepted as decidedly settled in favour of scaling in particular, the intrinsically correct and administratively venture-some approach has, no doubt, ushered in a new phase of innovation and experimentation in the history of major examinations in India. The measures were then considered to be the 'first steps' in the direction of examination reform and have since aroused a lot of interest particularly among experts in the field (see IUB Report on Higher Examinations, 1971). There is almost complete agreement among such experts on the need of randomization and scaling, although various suggestions have been made from time to time to use improved techniques of scaling. The Gauhati scaling method is very crude indeed, and a more realistic approach to the problem is necessary to remove large differences that occur in the subjective marking of scripts. The following account opens with a discussion of the median scaling method and the related tables (Taylor & Tluanga, 1963) developed for the purpose and subsequently presents a new table of scaling based upon the assumption of linear relationship between raw marks and scaled marks.

The method of median scaling

The method of median scaling assumes that the median of an examiner's marks is the only scalable indicator of his standard of marking. Since medians from a set of examiners are found to vary considerably, a common standard or norm for such examiners has to be established and this is done by taking as the required value the average of medians of all examiners belonging to the set. Then, if an examiner's median is found to differ appreciably, all the marks given by him to different scripts are scaled to the norm by a simple

process as outlined below. As a working rule to determine whether a certain median is scalable or not, however, only medians falling outside the range of twice the standard error of the norm are considered fit for scaling. The method assumes that the difference at any point of an examiner's distribution of marks and the distribution of marks of the corresponding norm is maximum at the median points and the differences proportionately diminish as we reach the tails of distributions. Thus, there is no difference between examiner's mark and scaled mark at 0 and 100, which concedes the position that very high and very low marks are not affected by a variable standard of marking. The situation is exemplified in the following rows of raw and scaled marks where the examiner's median is taken as 40 and the common or combined median 50. The scaled marks are determined by using Taylor-Tluanga Tables (op. cit.).

Examiner's mark	1	10	20	30	**40**	50	60	70	80	90	100
Scaled mark	1	13	25	38	**50**	58	67	75	83	92	100

In this example, the examiner's marks are scaled up to a maximum value of 10 at the equated median point. The raw marks at other points except at 1 and 100, are raised diminishingly from the median point by +8, +7, +5, +3, and +2 at 90 and by +8, +5, and +3 at 10. In scaling down the same general principle is retained as may be noted in another illustration below where examiner's and combined medians are assumed to be respectively 60 and 30.

Examiner's mark	1	10	20	30	40	50	**60**	70	80	90	100
Scaled mark	1	5	10	15	20	25	**30**	47	65	82	100

Here, examiner's marks are scaled down diminishingly from the equated median points by —23, —15, and —8 at 90 and by —25, –20, –15, –10, and –5 at 10. It may be observed in these examples that the proportionate increase or decrease of marks is not the same when the location of equated medians is at different points

from the coordinated scales. The discrepancy is easily understood when the principles of constructions of the scales are known from a brief sketch in the following lines.

By laying off the raw mark scale (0 to 100) and the common or combined mark scale (0 to 100) along the ++ coordinates of a graph median points are located in the common space for the axes. Since in the tables examiner's medians ranged from 28 to 60 and combined medians ranged from 30 to 50 both sets at two-point intervals, the plotted points for all tabulated medians appear to occupy a small rectangle in a slightly lower left region as shown in Fig. 1. Then, for a certain pair of equated medians, straight lines

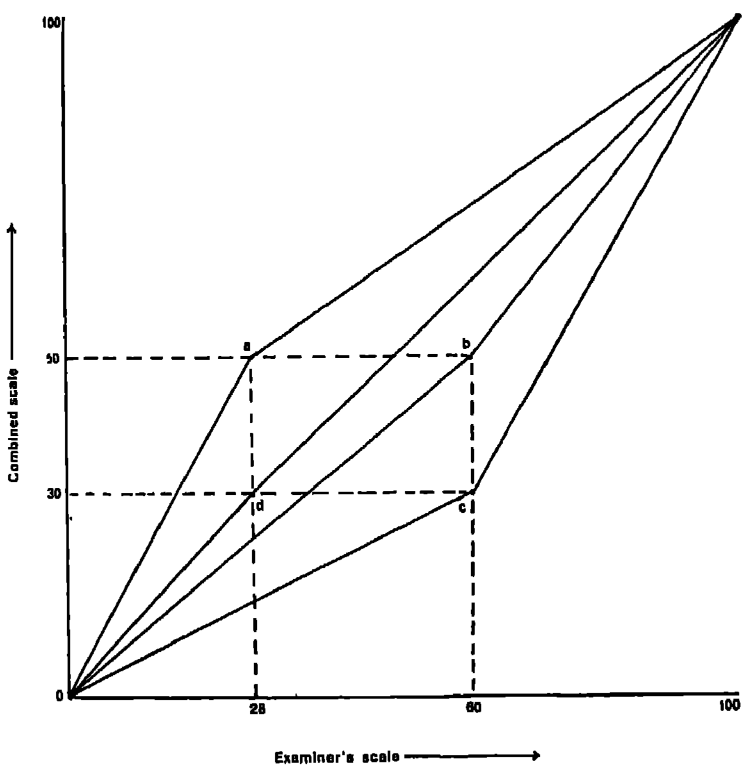

Fig. 1. Graphical exposition of Taylor and Tluanga scaling tables

are drawn from the plotted point to the extremes of 0 and 100 (as shown at points a, b etc. in Fig. 1.), and corresponding marks are

ascertained and entered in an appropriate column of one of the scaling tables. Working by equated medians in this way, scaled marks with respect to the raw marks are derived for all possible combinations and arranged under separate columns for combined medians. Thus, a particular table for a certain examiner's median exhibits in eleven columns scaled marks with respect to combined medians ranging from 30 to 50. In doing this exact halves and fractions more than exact halves are rounded off to the immediate higher number.

Limitations of the method of median scaling

Although the method of median scaling is a very simplified procedure and has been found convenient for adjusting marks in large-scale examination, it is remarkably defective for the same compelling reasons as have actuated people to rescue examinees from appalling uncertainities of marking. The most glaring defect of the system is that a difference between examiner's and combined medians is considered absolute in scaling marks up or down. That this difference at the medians can not be given such paramount importance is clearly borne out by common experience. The phenomenon of subjective standard of marking do not necessarily decrease as we go to the ends of a distribution: we do not find, for example, a liberal examiner most liberal only to mediocre students and lesser or least liberal to the poor and bright. Of course, such a consideration may be found compatible if we completely ignore mark distributions of examiners, or assume a triangular distribution of such marks as has been the case in framing the median scaling tables. But, can we possibly afford to ignore important characteristics of distribution of marks by examiners ? Or, do we have sufficient ground to assume a triangular distribution of marks? The author of the median scaling method admits himself in one of the writings that mark distributions of examiners broadly approximate to the normal curve and in many cases skewness is appreciable (Taylor,-, p. 24). There is then no ground to assume a triangular distribution by ignoring actual distributions and impose a kind of adjustment that misses the target by a wide margin.

It can be shown that scaling adjustment is not only occasionally necessary when the examiner's and combined medians are at the same point, but two opposite type of scaling are required as shown in the following illustration.

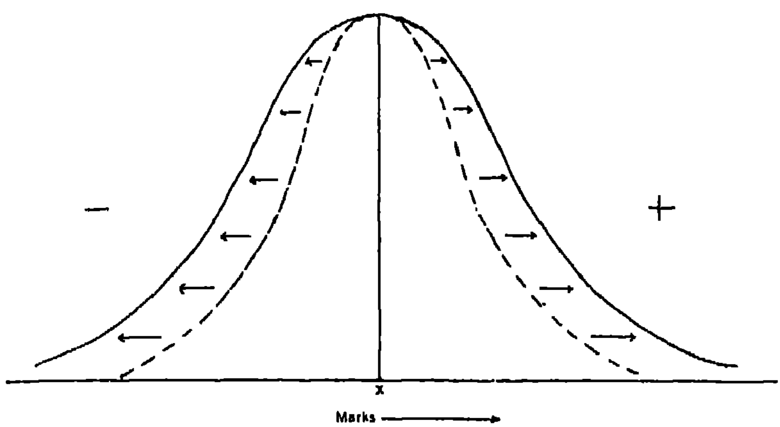

Fig. 2. Examiner (dotted) and combined (plain) distributions with the same median(x) but requiring opposite type of scaling.

The larger curve (plain) is taken as a combined distribution of which the smaller (dotted) constitutes an examiner's distribution. The median is at a common point x. It clearly shows the need for scaling at various points to close the gaps between the two distributions although the medians are at the same point. Besides, the scaling to the right of the median is of a positive nature while it is negative on the left side. Another important feature is that the magnitude of scaling increases as we proceed to the tails and is maximum at the extreme bends. This is in direct contrast to what is assumed in the method of median scaling. The situation does not clear up in favour of the method if distributions are skew rather than normal.

Other methods of scaling

The above major inadequacies of the method of median scaling are too serious to be ignored. It is needless to emphasize that the spread of distributions is as important as its central value and both have to be taken into account in any procedure for scientific scaling.

Due adjustment must be made for all sorts of examinees if at all scaling is considered essential to minimize the influence of subjective marking by examiners.

A very commonly used scale that may have application in such a problem is the percentile or centile scale. In this scale an examinee's percentile indicates the percentage of examinees in a group who score less than the examinee. Since a median corresponds to P_{50}, different examiners' medians may be equated to P_{50} to achieve a result similar to converting different medians to a combined median. The process may be carried on further and other points in distributions may be equated as percentiles of a scale. Thus, the deficiencies of proportionate scaling by the median method can be satisfactorily made up by the percentile method.

Why not then percentile scaling? There appear to be two very critical impediments barring its immediate utilization in examination work. First is our dogged subservience to traditional values like 'pass', 'division', 'distinction' etc. which makes the going not so easy more particularly when there is reluctance for ready acceptance of ideas and changes with compassion and understanding. If, for example, P_{50} is declared as the 'pass mark', it will be difficult to explain satisfactorily (and thereby assuage feelings) why an examinee fails although he scores a mark of P_{47}, much above an ordinary pass mark of 30 or 33. Similar difficulties will occur if conventional terms and concepts relating to examination are more appropriately defined and more sensibly interpreted than what they vaguely convey at present to our plain thinking on the subject. The second difficulty is a technical one. A percentile distribution is rectangular in shape. Therefore, it distorts the original mark distribution of an examiner and gives rise to occasional complicacies of interpretation of scaled marks at different points of an unrealistic distribution.

The most reliable measure of the spread of a distribution is its standard deviation which is found to be the least variable in samples drawn at random from the same population (Guilford, 1950, p. 95). This measure is often recommended for scaling in psychological and educational measurement and should, therefore, be given a fair trial in public examinations of our country. It did not, of course, escape the notice of Taylor when he was already through the

scaling business at the University. He remarked, 'Ideally, marks should be scaled so that all sets of marks have (a) the same mean or median, and (b) the standard deviation. Of these, (b) presents the more difficult problem, which needs further study before a solution can be applied with confidence' (1963, p. 12). In scaling with standard deviation also, one of the difficulties we mentioned in connection with the percentile method stands in a big way, i.e., raw marks are very much altered requiring a change in the estimation of such values. The standard deviation is itself a very small unit and wears a negative sign on one side of a distribution. Therefore, its use is out of question in examination work. A slightly improved scale is the C scale (Guilford, ib., pp. 302-306) with the negative signs omitted and the mean fixed at 5. But the unit is still too small for our purpose. The T scale is free from these two drawbacks, but requires changes in the system of evaluation of marks.

One of the scales based upon the standard deviation is a linear measure which takes any desired value for the mean and a similar value for the standard deviation. We may, therefore, conveniently substitute the combined mean and the combined standard deviation found out for a set of examiners and transform raw marks to such scaled marks that are interpretable from the point of values that exist to dominate the present system of examination. The relationship of a score ($X_{comb.}$) in this scale to a score (z) in the standard deviation or z scale is expressed as,

$$X_{comb.} = s_{comb.}\, z + M_{comb.} \qquad (1)$$

where, $X_{comb.}$ = a linear derived score called 'combined score;' $S_{comb.}$ = standard deviation of combined scores; and $M_{comb.}$ = mean of combined scores. Since z is being multiplied by a constant $s_{comb.}$ and is added to another constant $M_{comb.}$, the marks of an examiner bear a linear relationship to the combined scores in the new scale. A definite gain by such transformation is that, 'All properties of the original distribution of raw scores are duplicated in the distribution of these standard scores' for which 'any computation that can be carried out with the original raw scores can also be carried out with linear standard scores, without any distortion of results' (Anastasi, 1968, p. 53). Hence the technical difficulty we mentioned above in connection with percentiles is removed to clear

our way for a more dependable method of scaling of examination marks.

The equation (1) we just mentioned involves two steps, (i) transformation of raw marks to z scores and (ii) transformation of the same z scores to linearly derived marks for a practical consideration of scaling raw marks to scaled marks. This double transformation makes things look very laborious for quick examination work. We may then substitute for z the equivalent

$$\frac{X_{ex.} - M_{ex.}}{s_{ex.}}$$

where, $X_{ex.}$ = raw mark of an examiner ; $M_{ex.}$ = mean of all raw marks of the examiner ; and $s_{ex.}$ = standard deviation of raw marks of the examiner) and work out a new formula to simplify the procedure. Formula (1) is then written as,

$$X_{comb.} = s_{comb.} \frac{X_{ex.} - M_{ex.}}{s_{ex.}} + M_{comb.}$$

or,

$$X_{comb.} = \left(\frac{s_{comb.}}{s_{ex.}}\right) X_{ex.} + \left[M_{comb.} - \left(\frac{s_{comb.}}{s_{ex.}}\right) M_{ex.}\right] \quad (2)$$

and is made workable to obtain a linearly derived mark by a single operation. When we have a list of marks from an examiner, for $s_{comb.}/s_{ex.}$ is determined first and then by substituting this value along with the values for $M_{comb.} - M_{ex.}$ in the formula, we can work out the two constants required to transform raw marks to derived marks. Suppose, the mean and standard deviation of an examiner's distribution are given respectively as 33 and 8, and a mean of 40 and a standard deviation of 10 are known for a combined distribution. Then, the whole operation is reduced into—

$$X_{comb.} = \left(\frac{10}{8}\right) X_{ex.} + \left[40 - \left(\frac{10}{8}\right) 33\right]$$
$$= 1.25X_{ex.} - 1.25$$

Thus, we multiply every mark of a list by 1.25 and subtract 1.25 to find out the corresponding derived mark. Gulliksen (1950, pp. 274-275) has outlined a simple procedure by which score transformation tables can be prepared for a particular set of values.

It may be interesting by now to examine how marks scaled by the median method compare with scaled marks by the above linear method, particularly when—

(i) $M_{ex.} = M_{comb.}$ but $s_{ex.} \neq s_{comb.}$ and

(ii) $M_{ex.} \neq M_{comb.}$ but $s_{ex.} = s_{comb.}$

TABLE 1

Scaled marks by the linear and median methods.

(*i*) Linearly derived marks, $M_{comb.} = 40$, $s_{comb.} = 15$		1	10	25	40	55	70	85	99		
Examiner's marks $M_{ex.}$ or $Mdn_{ex.} = 40$, $s_{ex.} = 10$	1	10	20	30	40	50	60	70	80	90	100
(*ii*) Linearly derived marks, $M_{comb.} = 34$, $s_{comb.} = 10$		4	14	24	34	44	54	64	74	84	94
Scaled marks by the Median method $Mdn_{comb.} = 34$	1	8	17	25	34	45	56	67	78	89	100

In the first comparison (the first two rows of Table. 1.), since $M_{ex.} = M_{comb.}$ the question of median scalling does not arise; but because $s_{ex.} \neq s_{comb.}$, the differences between examiner's and linearly derived marks strikingly appear so as to justify the need of scaling although medians in both distributions remain the same. Secondly with $M_{ex.} \neq M_{comb.}$ but $s_{ex.} = s_{comb.}$, the scaled marks in the last two row markedly differ. The scaled marks by the median method are lower than examiner's marks excepting at 0 and 100 (since $M_{comb} M_{ex.}$) by a rate different from the scaled marks by the linear method. The rate is proporiionate in the median method, but it is uniform in the latter because $s_{ex.} = s_{comb.}$

Quick scaling by the linear method

In large-scale examination work, speed and accuracy must not suffer because of introducing a new method. The scaling procedure must be so adjusted that necessary changes are swiftly and unerringly recorded by the side of raw marks submitted by an examiner. Even by using a hand-operated calculator, the transfer of scaled marks to the mark-sheet may not be so straightforward since marks in the sheet may not appear in a serial order. The preparation of a table every time a new mark-sheet is taken up as suggested by Gulliksen (ut. sup.) is certainly unnecessary and time consuming. As table reading is comparatively easier and safer than ordinary machine calculation, an attempt has been made in the following paragraphs to simplify the procedure of reading linearly derived marks from a newly designed table (Table. 2.).

Since the new set of scaled marks bear to raw marks a linear relationship, graphical or tabular determination of scaled marks for a specified set of means and standard deviations is comparatively an easy task. But a variety of combination of means and standard deviations, like those we face in examination work, complicate the whole issue. If in a paper the maximum mark is fixed at 100, we may expect the mean to vary from examiner to examiner in different papers or subjects or in different examinations within an approximate range from 20 or 25 to 75 or 80 in randomized samples of scripts. Then to the large constellation of various combination of means, we have to juxtapose another constellation of different combination of standard deviations, ranging perhaps from 5 to 25 in similarly randomized scripts. This makes our task at the first sight almost an impossibility.

Now, looking back at our formula (2) for a derived standard score, we note that the ratio $s_{comb.}/s_{ex.}$ determines the angularity of the line of relationship between raw marks and derived marks represented along ++ coordinates of a graph. Therefore, it is possible to find out some fixed values by which the angle steadily varies to represent various ratios of $s_{comb.}/s_{ex.}$ so that a closely similar line of relationship approximates the actual line in the determination of scaled marks. The angle is nearly 64° when $s_{comb.}$/ is

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$\frac{s_{co}}{s_{ox.}}$	0.49	0.51	[illegible]		
1—	0	1	[illegible]		
2—	1	1	1		
3—	1	2	2		
4—	2	2	2		
5—	2	3	3		
6—	3	3	3		
7—	3	4	4	4	
8—	4	4	4	4	
9—	4	5	5	5	
10—	5	5	5	6	6
11—	5	6	6	6	6
12—	6	6	6	7	7
13—	6	7	7	7	8
14—	7	7	7	8	8
15—	7	8	8	8	9
16—	8	8	9	9	9
17—	8	9	9	9	[illegible]
18—	9	9	10	10	[illegible]
19—	9	10	10	11	[illegible]
20—	10	10	11	11	
21—	10	11	11	12	
22—	11	11	12	12	
23—	11	12	12	13	
24—	12	12	13	[illegible]	
25—	12	13	13	[illegible]	
26—	13	13	14	[illegible]	
27—	13	14	14		
28—	14	14	15		
29—	14	15	15		
30—	15	15	[illegible]		
31—	15	16	[illegible]		
32—	16	[illegible]			

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double than $s_{ex.}$ and is about 27° when $s_{comb.}$ is half its corresponding $S_{ex.}$ Changing the angle by unit degree, we can read off ratios as natural tangents to constitute a number of fixed values ranging from .49 to 2.14 as shown in the top row of Table. 2. In practice, the nearest value (correct to the second decimal place) of an actual calculation ($s_{comb.}/s_{ex.}$) may be considered sufficient for our purpose.

Table. 2. is prepared in a simple manner by arranging in a column headed by a particular $s_{comb.}/s_{ex.}$ ratio all the appropriate values of the linear scale as they correspond to values in the raw marks scale. Such linear marks in the table are rounded off to the nearest whole number as fractions do not matter in the procedure. this way values for all columns of $s_{comb.}/s_{ex.}$ ratios ranging from .4877(26°) to 2.1445(65°) are entered to complete the table. Lastly, at the left marginal column of the table a sliding scale is provided, called the Sliding Raw Marks Scale, which is to be neatly cut off and used to find scaled marks in the manner as explained in the next paragraph.

Once the standard deviations of both examiner and combined distributions are known, the $s_{comb.}/s_{ex.}$ ratio is worked out and the nearest tabulated value is selected in the top row of Table. 2. Then, the mean of the examiner's distribution is located in the slider and the same is held opposite the mean of the combined distribution found in the appropriate column. Now, holding the slider fixedly at this point. where $M_{comb.} = M_{ex.}$, other scaled marks are read off as they appear against marks in the slider. This manner of reading scaled marks from a table provides the easiest, safest and the most rapid procedure in examination work. Sticking the slider permanently along a selected column of marks in a consumable table leaves a much desirable record of scaled marks for a particular mark-sheet for any subsequent use or verification of results.

There are two minor difficulties we may face in using the table when the ratio is about half or double in the extremes. If it is about half, the same mark occurs twice as in the column for .49. In such a case the mean located at the slider should be adjusted to the first mark in the column if the actual ratio is larger than the estimated

ratio. On the other hand, the mean of the slider should be adjusted to the second figure if the actual ratio is smaller then the estimated ratio. Secondly, when the ratio is about double, marks jump from step to step mostly by twice its own unit as in the column far 2.14. In such a case, the mean of the slider should be adjusted to the next lower value in the column if the actual ratio is smaller than the estimated value and vice versa. The slider may also, in such a case, be adjusted conveniently for interpolation of scaled marks intermediate between tabulated values.

An alternative to the above procedure is to wark out on-the-spot with the help of a calculator the scaled marks and enter the same in a partly printed schedule specifically prepared for the purpose. The printed form of the schedule may be necessary to ensure quick work, where the whole range of raw marks are printed in two or four columns by the margin of which scaled marks are recorded to make an 'individualized' mark transformation table. In doing this, it is better to begin the work from the mean of the examiner's distribution toward any one end first and the other next. It is then from this schedule, scaled marks are entered in the examiner's mark-sheet. The only trouble with this procedure is that we have to prepare every time a table when a new mark-sheet is taken up for scaling.

Conclusion

It has already been mentioned that mark distributions of examiners are largely of the normal type, though in many cases distributions tend to be appreciably skewed. Other peculiarities like the 'J-shaped' distribution (Taylor, 1963, pp. 13-19) are not quite unlikely, especially when examiners are allowed to mix up examination with evaluation. What to do with such distributions that deviate from the normal? If the original shape of a distribution is desired to be retained as it is, linear scaling may be found to be useful in most cases. But if the spread of an examiner's mark is too small in comparison with the spread of combined marks and is on one side of the scale, smaller differentiation showing in marginal cases may disappear as a result of scaling. The situation may be sometimes pretty serious with a J-shaped distribution. Do we then go on

changing the procedure and adopt a new scaling technique any time we face a peculiar distribution, or look elsewhere at the controls of examiner behaviour?

It must be noted at this point that scaling, to whatever length the refinement is carried on, is no answer to all problems of examination and evaluation. It is no substitute for good examination and a problem of good examination must not be sought to be solved though a good method of evaluation. The deviation of mark distribution from the normal shape, especially when scripts are thoroughly randomized, is more likely a problem of examination than evaluation. Naturally, its solution should be explored in the process of examination even if such a probe necessitates reorganization of the whole procedure at considerable expense.

Finally, it has to be admitted that this manner of scaling marks of essay examiners does not provide a more useful 'scale' of relative performance by examinees. We can not compare performance of examinees even in the same paper examined and scaled in different zones. We can not say the performance of an examinee in one subject is better than his performance in another subject. The bare scaled marks are no better than raw marks excepting that they are adjusted to a common standard of marking. Could we not make another bold move and make good of the use of the present limited scaling procedure to a more generalized system of mark evaluation throughout the country?

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On the Estimation of the Average Proportion of Failures at a University Examination

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Anjani K. Sinha

It is a matter of common experience that the percentage of failures at a particular type of examination is not constant from year to year. A number of reasons may be ascribed to this variability. In the present paper the aim of the authors is not to go into the causes which make this sort of variation. Instead, they have tried the different techniques for estimating the average proportion of failures on the basis of certain supplied data.

Material and Method.

The proportion of failures under discussion are those of the Pre-Science students of Patna University. Holding of Pre-Science examination was started in 1960 at this University. Till 1962 only annual examinations were held. From 1963 onwards annual as well as supplementary examinations are being held.

From the relevant tabulation rolls the number of candidates appearing at the examination and the number of candidates who failed were noted down. The students were dichotomised as colle-

giate and non-collegiate. These data together with the calculated proportion of failures are shown in Table I and II:

TABLE 1

Failures at the Annual Pre-Science examinations of Patna University

Year of examination	Collegiate Students			Non-Coelegiate students		
	n_i No. appeared	di No. failed	$p_i=d_i/n$ Prop. of failures	n_i No. appeared	d_i No. failed	$p_i=d_k/n_i$ Proportion of failures
1960 A	577	198	.3431	—	—	—
1961 A	574	200	.3484	142	59	.4155
1962 A	585	189	.3231	176	69	.3920
1963 A	531	152	.2862	211	76	.3602
1964 A	668	212	.3174	150	101	.6733
1965 A	665	170	.2556	238	108	.4531
1966 A	698	145	.2077	181	61	.3370
1967 A	822	273	.3321	186	45	.3308
1968 A	737	187	.2537	281	78	.2776
1969 A	772	189	.2448	209	54	.2584
1970 A	800	218	.2725	207	71	.3430

TABLE II

Failures at the supplementary Pre-Science examination of Patna University

Year of examination	Collegiate Students			Non-Collegiate students		
	n_i no. appeared	d_i no. failed	$p_i=d_i/n_i$ proportion of failures	n_i no. appeared	d_i no. failed	$p_i=d_i/n_i$ Proportion of failures
1963 S	30	18	.4615	26	3	.1154
1964 S	43	28	.6512	24	13	.5417
1965 S	46	9	.1956	36	3	.0833
1966 S	47	8	.1702	12	3	.2500
1967 S	47	11	.2340	—	—	—
1968 S	35	10	.2857	—	—	—
1969 S	19	7	.3684	21	5	.2381

Theory

Suppose we are considering the data of K years. Let n_i and di $(i = 1, 2...k)$ respectively denote the number of candidates who appeared and those among them who failed in the i th year. Consequently $p_i = d_i/n_i$ gives the proportion of failures in the i th year. One way of estimating the average proportion of failures would be to find $\bar{p} = \sum_{i=1}^{k} p_i/k$ which is nothing but the simple arithmetic mean of the different proportions of failures. Had the number of candidates appearing been constant throughout the years, the data of which are under consideration, $\bar{p}$ would have been a valid estimate of the average proportion of failures. But the number of candidates appearing is not constant from year to year. In such a situation we know from the theory of statistics that a better estimate is $\bar{p}_w$ —the weighted mean of p_i's, the weight of p_i being n_i, the

number of candidates appearing. And so we have a second estimate $\bar{p}_w = \frac{\Sigma n_i \ p_i}{\Sigma n_i} = \frac{\Sigma d_i}{\Sigma n_i}$. It is apparent that $\bar{p}_w$ can be directly calculated from a knowledge of ni's, and d_i's. without calculating p_i's.

Now let us imagine a situation in which the data supplied contain only the value of p_i's while nothing is known about n_i and d_i. And there is reason to believe that n_i is not constant for the period under consideration. How are we going to combine the supplied values of p_i's in order to get a valid estimate as far as possible ? Clearly the question of calculating $\bar{p}_w$ does not arise. $\bar{p}$ can be calculated but it has its demerits. Then what should be the next choice? We know that when the analysis of variance technique is to be applied to a set of data where the variable is not having a constant variance but is known to be of a binominal type, one usually applies $\sin^{-1}\sqrt{x}$ transformation to get a transformed set of variable having a constant variance. The conventional procedure of analysis of variance can then be applied to the transformed variable. We get light from this theory to tackle our problem.

Knowing p_i's it is easy to obtain the values of $\sin^{-1}\sqrt{p_i}$ in radian. Let $\theta_i = \sin^{-1}\sqrt{p_i}$. Then $\bar{\theta} = \sum_{i=1}^{k} \theta_i / k$. Suppose p_t be the average value of p_i's which is to be obtained by utilising this transformation. Then we can write $\sin^{-1}\sqrt{\bar{p}_t} = \bar{\theta}$. So $\sqrt{\bar{p}_t} = \sin \bar{\theta}$, and therefore $\bar{p}_t = (\sin \bar{\theta})^2$. Actual calculation supports our hypothesis that $\bar{p}_t$ will be nearer to $\bar{p}_w$ in comparison to $\bar{p}$.

We have indicated in the beginning that the variation in the proportion of failures is due to many factors. Broadly speaking these factors may be categorised as assignable and non-assignable cause of variation—a terminology which we have borrowed from Industrial Statistics and Quality Control. To get a revised value of $\bar{p}_w$ which is free from the assignable causes of variation, we may adopt a process which is similar to that applied in the field of Industrial Statistics provided that n_i and d_i are also known. We may compute the usual 3-sigma control limits and draw a p-chart which in our case we shall term as a fraction failure chart. If for

some i, plotted p_i goes outside the control limits, fresh values of $\bar{p}_w$ and control limits are calculated by eliminating the set of observations corresponding to that i. In this way all the trouble-making Pees are eliminated. The final $\bar{p}_w$ which is denoted as $\bar{p}_{wf}$ may be taken as an estimate of average proportion of failure which is expected in the long run.

It may be argued that the geometric mean is sometimes recommended for calculating the average of ratios, and p_i's may be thought of as a sort of ratios. So why not adopt a geometric mean in this case ? Calculation was made to explore that feasibility aslo. $\bar{p}_g$'s the geometric means, were calculated in different cases. In no case $\bar{p}_g$ was found to be better than $\bar{p}_t$.

Results

TABLE III

The different values of $\bar{p}$, $\bar{p}n$, $\bar{p}g$, and $\bar{p}t$

Criteria of Classification	*Estimators*			
	$\bar{P}$	P_w	$\bar{P}_g$	$\bar{P}_t$
Collegiate (A)	.2895	.2871	.2860	.2882
Non-Collegiate (A)	.3841	.3739	.3708	.3818
Collegiate (S)	.3381	.3298	.3051	.3322
Non-Collegiate (S)	.2457	.2209	.1190	.2291

It is clear from data in Table III that in all the cases $\bar{p}$ and $\bar{p}_t$ ar egreater than $\bar{p}_w$, whereas $\bar{p}_g$ is less than $\bar{p}_w$. If we take $\bar{p}_w$ as standard and calculate the percentage of absolute differences of the remaining estimates from $\bar{p}_w$, we get the following values shown in Table IV.

TABLE IV

The absolute percentage difference of $\bar{p}$, $\bar{p}_g$ and $\bar{p}_t$ from $\bar{\bar{P}}_w$

Criteria of Classification	*Estimators*		
	$\bar{p}$	$\bar{p}_g$	$\bar{p}_t$
Collegiate (A)	2.47%	.38%	.38%
Non-Collegiate (A)	2.72%	.83%	2.11%
Collegiate (S)	2.52%	7.49%	.73%
Non Collegiate (S)	8.28%	12.29%	.97%

It is evident that on the whole $\bar{p}_t$ is nearer to $\bar{p}_w$ in comparison with other estimators; so in cases where we have to average a given set of proportions of failures only the estimator $\bar{p}t$ might be our first choice.

We may point out at this stage that the problem of averaging a set of ratios is not limited to the field of Education only. In many branches of natural as well as Social Sciences the same type of problem may occur. For example sake, we may point out a problem in demographic research. The proportion of births and deaths for several years might be known but the exact number of those born or dead during the same period might not be known. It is required to find out the average proportion of birth or death in these years. To tackle such a problemwe suggest the use of $\bar{p}_t$, which we very much believe will give a reasonable estimate in such a situation.

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Objective and Traditional Question Papers

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The author has attempted to convert essay type questions in geography into objective questions by selecting points picked out from among answers to essay type questions, identifying important points in the answers with the help of teachers. Examples of each type, questions of fact, questions requiring explanation or discussion and questions using a map are given. The study shows that objective tests so prepared were more efficient in measuring achievement and spent less student time than essay questions. It is based on administration of tests to 113 *and* 97 *pupils respectively. The criticism that guessing is encouraged in objective tests is experimentally rebutted.*

As early as 1950 the University Education Commission (p. 327) observed: "For nearly half a century, examinations, as they have been functioning, have been recognised as one of the worst features of Indian education in India .... We only note that while the magnitude of the problem has been growing at an alarming rate nothing constructive in the way of reform has happened." Most of us would admit that during the last twenty-two years there has been little improvement in our university examinations. The situation

has been steadily worsening. Now it has reached a critical, probably a breakdown, stage.

To improve examinations various suggestions have been made. In fact, each aspect of our examinations does need improvement. For some improvements we may afford to wait. The introduction of modern techniques of data processing is such an improvement, since it involves funds and readjustment in the existing examination staff. But there are other improvements which we can introduce *now*. Amongst these the most important and the most feasible is the improvement of the question paper. This does not require additional funds, additional staff, or retrenchment of anyone from the employment. This would improve teaching and learning practices, and probably also the tone and discipline of educational institutions, as these are mostly governed by the way we measure students' achievements (see also Hill, 1972). Almost all the secondary boards in the country have taken up question paper improvement, thus if our universities take this up none will consider it drastic.

There are several ways to improve traditional question papers. Essay-type questions, as they are used now, can by far be improved. Then, we can include some other types of questions; e.g. short answer-type requiring answers in a few sentences, fixed response-type requiring answers in a few words, and objective-type requiring the selection of the most appropriate answer out of several appended to a question. Of late, a few universities have started the use of short answer-type, and fixed response-type questions on an experimental basis. But objective-type questions have not been given even a fair trial by our universities. This is obviously due to the lack of confidence in such questions. There is a feeling that objective-type questions cannot cover the material tested by traditional question papers. It is also felt that objective test marks would not be as dependable as traditional test marks, because objective tests provide an opportunity to guess answers while traditional tests do not. The feeling is quite natural especially when these problems have not been properly investigated in the country. The present study was designed to do this job.

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CAN TRADITION TEST MATERIAL BE COVERED BY OBJECTIVE TESTS?

Review of the Literature: The answers to the above question are based mostly on opinions. Of course, there are a few empirical evidences also. Let us first consider the opinions. Some experts (Vernon, 1940; Wrightstone, Justman, and Robbins, 1956; Thorndike and Hagen, 1961; Examination Committee, UGC, India, 1962; and Standards Committee, UGC, India, 1965) hold that essay-type tests measure those larger outcomes of education which may not be measured by other paper-and-pencil-type tests. Implicit in this claim is that objective tests do not and cannot measure the larger outcomes of education. There are others who do not agree with this view. Sims, 1948; Stalnaker, 1951; and Noll, 1957 feel that this claim of essay-type tests is generally accepted without proof, evidence, or supporting logic. Ballard, 1923; Diederich, 1957; Nedelsky, 1957; Engelhart, 1957; Ryans, 1958; Frederiksen, 1960; Kelly, 1963; Harper, 1963; Hubbard, 1963; and Hill, 1964 are more assertive of the capabilities of objective tests. They hold that most of the educational outcomes measured by essay-type tests can be measured by *good* objective tests. Ebel, 1953; and Anastasi, 1966 are of the view that the impression that objective tests can measure only trivial educational objectives is probably due to the fact that such objective tests can be easily prepared by unskilled writers.

Coming to empirical evidence, there have been very few studies on this problem. All of them have been done in foreign countries. (Sims quoted in Woods, 1953; Woods, 1953; and Moore, 1954). These studies suggest that most of the material covered by essay-type tests could be made objective. They conclude that teachers use essay-type tests where objective tests would have done the job better.

Design of the Present Study: It was considered desirable to analyse question papers set at different levels of education. To start with we selected class X final examinations, which serve for all practical purposes as the admission tests for most of our universities. The present report deals with the results of an analysis of Geography question papers set in class X final examinations in Assam. In Assam, prior to 1964 class X examinations were conducted by the Gauhati University and called Matriculation examinations. Since 1964, they

have been conducted by the Board of Secondary Education, Assam, and called High School Leaving Certificate (H.S.L.C.) examinations. All the questions set in Matriculation/H.S.L.C. examinations of Assam for the years 1961-66 were compiled. To each essay-type question, so compiled, two to four teachers in Geography in higher secondary schools of Assam independently wrote answers. We sorted out the common points of answers for each question. These were considered the correct answer to that question, and were converted to objective items with the help of subject teachers.

It was found that there were mainly three types of questions, varying in the degree of objectivity. Each of the three types was found, as shown below, convertible to objective items.

In the First Type are the questions which are purely factual. Below are a few examples of the First Type:

1. State the location and importance of the following: Bangalore, Chittagong, Pittsburg, Montreal, Quito, Moscow and Berlin. (Q. 13, H.S.L.C., 1964)

2. Classify a mountain in as many types as you can according to origin. Give an example of each type. (Q. 4, H.S.L.C., 1965)

Such questions can easily be converted to objective items. The following are some examples:

I. *Question 1 converted to objective items*

Directions: In List A are given towns. In List B are given description of the towns. Opposite each item in List B, put the number of the town (from List A) to which the description applies. There are some extra items in List A. Example P has been solved for you. Solve the rest of the questions in the same way.

List A Towns *List B Descriptions*

II. *Question 2 converted to objective items*

Question 2 may be split into two parts: (A) Classify a mountain into types according to origin. (B) Give an example of each type.

(a) *Conversion of Part (A)*: *Direction*: In the brackets opposite each statement put an X mark in the column or columns to which the statement applies. Examples P and R are solved for you. Solve the rest of the questions in the same way.

	Mountain	*Rock*	*Climate*	*None*
P. "Fold" is a type of	(X)	( )	( )	( )
R. "Equatorial" is a type of	( )	( )	(X)	( )

(b) *Conversion of part* (B) : *Directions*: The same as for question 1.

List A Answers *List B Questions*

Q. What types of mountains are the Alps? ( )

In the Second Type are the questions which require explanation or discussion. Below are a few examples of the Second Type:

1. Discuss why Africa is called a Dark Continent? (Q. 11, H.S.L.C., 1963)

2. Compare and contrast the rivers of Northern India with those of the Deccan. (Q. 9, Matriculation, 1962; and Q. 8, H.S.L.C., 1966)

Conversion of such questions to objective items is somewhat more difficult. The following are some examples:

I. *Question 1 converted to objective items*

Directions: To each of the following questions several answers are given, out of which only one is correct. Write the number of the correct answer in the bracket opposite the question. Example P is solved for you. Solve the rest of the questions in the way.

Q. Why is Africa called the "Dark Continent"? ( )

1. Some places in the continent are still inaccessible to man.
2. People are dark-coloured there.
3. There are thick jungles, which remain dark even during day time.
4. Till recently people were in dark about the interior of the continent.
5. None of the above is correct.

II. *Question 2 converted to objective items*

Directions: The same as for Question 1.

Q. Which of the following statements is *not true* for rivers of Northern India?

1. Generally river water keeps on flowing throughout the year.

2. Generally rivers are deep and wide.
3. Generally rivers have the upper stage.
4. Generally rivers are useful for hydro-electric purposes.
5. All the above statements are generally true.

Similar questions may be asked to test students' understanding of rivers of Northern India and Deccan.

In the Third Type, are the questions which require drawing of diagrams, and map of India. The number of such questions is very small, twelve out of a total of seventy-six questions. Out of twelve such questions, six were on drawing a full-page map of India—a question asked every year—and indicating on it the towns, rivers, etc. as asked in the question paper. The remaining six questions required drawing of diagrams to explain revolution and rotation of the earth and showing the wind circulation of the world, the distribution of various types of rainfall, and the movement of the Gulf Stream.

Below are a few examples of the Third Type:

1. Draw a full-page map of Indian Union and insert on it the following:
   (a) The Aravallis, the Naga Hills, the Vindhyas.
   (b) The Tapti, the Krishna, the Jumna.
   (c) Logtak lake, Palghat gap, and Kutch.
   (d) Chittaranjan, Bangalore, Gauhati, and Srinagar.

(Q. 1, H.S.L.C., 1966)

2. What do you know about the rotation of the earth? Explain with a neat diagram the results of the rotation. (Q. 2, H.S.L.C., 1966).

Both questions 1 and 2 may be split into two parts: (A) Drawing of a map or diagram. (B) Indicating on map certain places, or explaining certain geographical phenomenon with the help of the diagram. According to teachers, part (A) measured students' ability at free-hand drawing. Thus part (A) could not be converted to objective items. (Harper in a personal communication remarks that, after all, map-drawing is not an "essay-type" question either.) But part (B) was found convertible to objective items. The following are some examples:

I. *Question 1 converted to objective items*

Conversion of part (B) : *Directions*: Look at the above map. In

the map cities are marked as 1, 2, etc. Some of these cities are listed in questions noted below; but not in the same order. In the bracket opposite each name write the number of the city as shown in the map. Example P is solved for you. Solve the rest of the questions in the same way.

Cities *Number as shown in the map*

Similar questions may be asked for rivers, hills and lakes.

II. *Question 2 converted to objective items*

Conversion of part (B): Directions: The same as for question 1 in the Second Type.

Q. Which of the following diagrams shows correctly the rotation of the earth? ( )

1. (Diagram 1)
2. (Diagram 2)
3. (Diagram 3)
4. (Diagram 4)
5. None of the above diagrams.

Q. In what time does the earth move around the Sun?

1. About 12 hours.
2. About 24 hours.
3. About 30 hours.
4. About 365 days.
5. None of the above is correct.

Similar questions may be asked to test students' knowledge of the results of rotation.

TABLE 1

Conversion of essay-type questions to objective items

Number of essay questions asked in Matriculation and H.S.L.C. examinations during 1961-66.	76
Number of separate points mentioned by teachers as answer responses to the essay-type questions	482
Number of separate points capable of conversion to objective items	470
Number of separate points which require drawings to be reproduced in answer to essay-type questions and which were not found capable of conversion to objective items	12

Table 1 shows the details of the points converted to objective items. The Table shows that the seventy-six essay questions asked during 1961-66 included 482 separate points of answer (including 12 drawings) of the total 482 points, 470 points were found capable of conversion to objective items.

Guessing in Traditional and Objective Question Papers

Objective Tests

To find out empirically the influence of guessing in objective tests, we constructed two objective tests. As already shown in Table 1, four hundred and seventy objective items could cover the entire material asked in class X final examinations in Assam during 1961-66 (leaving, of course, the portion requiring map-drawing or diagram-drawing). Out of these four hundred and seventy items, four hundred and forty items were split into two objective tests in a way that the two become parallel as far as the coverage of course content and the assumed difficulties of items are concerned. This is what we could possibly do to make the two tests comparable without pretesting and item analysis. Each test was of two hours' duration. Both the tests were administered to a group of class X students when they had completed their course and were ready to proceed on preparation leave. The students were told that these tests would enable them to locate their weak and strong points, which will be helpful in preparation for examination. The tests were administered in almost real examination situation with proper seating and invigilation arrangements. The students took the tests on two consecutive days. Each day an essay-type question paper in Geography was given in the forenoon and the objective test in the afternoon. The two essay-type question papers were the question papers set in the H.S.L.C. examinations in 1965 and 1966 in Geography. We wanted to change the order of tests on the second day, i.e. having objective test in the forenoon and the essay-type test in the afternoon, so that the effect of extraneous factors, if any, like fatigue, ventilation, etc. is evenly distributed on the two types of tests. However, this could not be possible due to administrative difficulties. The numbers who took the two essay-type tests were 116 and 99 respectively. The numbers who took

the first and the second objective tests were 113 and 97 respectively. The number of the drop-outs was as usual in school tests. Each objective test had 71 matching-type questions, 24 multiple-choice questions, and 127 true-false questions.

Correction for Guessing: Objective tests require students to select one of several answer responses already given in the test. Thus, it is possible that a student selects the right answer just by guessing without knowing the answer. To ensure that students in general do not significantly gain by wild guessing, some people suggest a correction for guessing in scoring objective tests. There are others who do not favour correction for guessing. The reason is that practically all the formulae for the correction assume that a student gives a wrong response only due to guessing. In many cases this assumption may not hold good. Some students may select a wrong answer due to mis-information or defective distractors in the item. The correction for guessing would unduly penalise such students. Our initial problem, therefore, was whether to make correction for guessing or not.

Traxler (1951, p. 367) observes that, "Among the kinds of objective tests, there is one common type for which the use of a correction formula has seldom been advised. This is matching test". We agreed with Traxler and made no correction for matching-type items.

In multiple-choice items, an attempt was made to make all distractors appear to be such plausible answers that there was a high probability that each examinee, who did not know the correct answer, would select a wrong response which seemed correct to him, and not just guess. Traxler (1951, p. 349) recommends the use of no correction for guessing in such cases. Ebel (1965, p. 229) says that "Well-motivated examinees who have time to attempt all items, guess blindly on few, if any, items." Our analysis revealed that about 80% to 90% of the examinees were able to complete each of the objective tests. This indicates that most students had time to attempt all the items. As already stated the students were well motivated to appear for the tests. We agreed with Traxler and Ebel and made no correction for guessing in multiple-choice items. A probable effect of noncorrection for guessing would be that an average student who guessed answers would score higher than what he would have scored after correction.

In true-false items, guessing would considerably increase error variance. If the raw scores of students on matching-type, multiple-choice, and true-false items were added; the true-false would have a very different weightage from the matching-type. Thus for true-false items the standard correction for guessing was applied:

$S = R - W$ (Correction for guessing in true-false items) (1)

Where S stands for score, R for number of right responses, and W for number of wrong responses.

Scaling of Objective Test Scores to "Out of 100 Marks" Scale

Our aim was to compare the effect of guessing in objective and traditional tests in terms of marks. Each essay test was of 100 marks, so it was necessary that objective test scores be also converted to "out of 100 marks" scale. For this the method described by Gulliksen (1950) which was suggested to us by Dr. A. Edwin Harper, Jr. in a personal communication, was applied as stated below.

As already mentioned, the same students appeared for two essay-type tests in Geography. The scripts of each essay-type test were independently marked by two competent examiners—examiners 1 and 2 marking the first essay-type test, and examiners 3 and 4 the second essay-type test. The average of the highest marks given by the four examiners was taken to be the optimum highest mark for each objective test. Similarly, the lowest marks given by the four examiners were averaged to find out the lowest mark for each objective test. The average numbers of students in the I, II, III, and Fail categories in the four markings were calculated. A graph was drawn by fixing critical points at the highest and the lowest marks and at each division level, so that the numbers of students in the I, II, III, and Fail categories and the highest and the lowest marks in each objective test remain approximately the same as for the average of the four markings of the essay-type tests.

Chance Statistics for Objective Tests

After having converted objective test scores to "out of 100 marks" scale, we investigated to what extent one could get marks in the objective tests by sheer guessing. We calculated the chance statistics for objective tests. The maximum chance score for the purpose of the calculation was defined at the 1% level or $2.33\sigma_c$ above

the mean chance marks. We considered a one-tailed test useful in the present context, as we were interested in only chance marks significantly *above* the means. The following formulae were used for the calculation of the chance marks.

For uncorrected scores

$$M_c = Np \qquad (2)$$

$$\sigma_c = \sqrt{Npq} \qquad (3)$$

For corrected scores

$$M_c = N(p - kq) \qquad (4)$$

$$\sigma_c = (1 + k)\sqrt{Npq} \qquad (5)$$

Where M_c is the mean score obtained by chance,

σ_c is the standard deviation of the scores obtained by chance

N is the number of the items in the test,

p is the probability of answering an item right by chance,

q is $1-p$,

and k is the correction factor.

Shall a student pass by sheer guessing in objective tests?

Table 2 gives the summary of the chance statistics for the two objective tests. The Table shows that if a student, who did not know

TABLE 2

Summary of chance statistics for the objective tests

Statistics	*Below average chance score*	*At average chance score*	*Between average and maximum possible chance score*	*Completely above chance score*
Raw Score				
First Test	Below 14	14	15—51	52—222
Second Test	Below 14	14	15—51	52—222
"Out of 100 marks scale"				
First Test	Below 8	8	9—25	26—100
Second Test	Below 10	10	11—25	26—100

the answer to any item, answered all items on the first or second objective test by guessing alone, he would (on the average) get 14 raw scores, or 8 marks "out of 100 marks" scale. There is almost no chance of getting a raw score above 51, or 25 marks on the "out of 100 marks" scale just by guessing.

It may be pointed out that the number of questions in the objective tests is usually so large that there is little scope of guessing the questions of the objective tests. Here guessing is confined to the selection of right answers. As has been shown above, if one does not study and confines his preparation to guessing alone, he would almost certainly fail in the objective tests.

Do students wildly guess in objective tests?

It seems reasonable to assume that if students wildly guess, most students would get the scores that could be obtained just by guessing. Tables 3 and 4 show the relationship between the number of items attempted and the raw scores obtained for the first and the second objective tests respectively. These Tables are based on the method of analysis used by the Educational Testing Service, U.S.A. (see also Gulliksen, 1950, p. 247). For these tables "not reached" and "omitted" items were treated as not attempted. In the tables, the figures

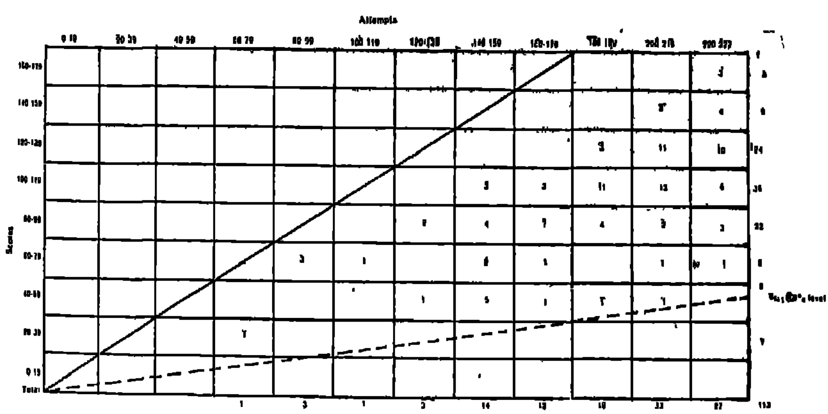

Table 3

Relationship between the number of items attempted and the scores obtained on objective test.

in the rows show the scores obtained; the figures in the columns show the number of items attempted. The dotted line at the bottom sets the limit of getting the maximum possible scores by sheer guessing. One out of 100 cases (on the average) falling on this line would get the obtained scores by guessing without knowing the answers. It may be marked that all the cases in the tables are beyond the dotted line. If students in general did guess blindly, most of them would have fallen below the dotted line. The evidence of the tables does not support the common apprehension in the country that in objective tests students would resort to wild guessing in answering items.

It is sometimes argued that students do not guess wildly if the items are very easy, since in such a case most students would know the answer, and would have no need to guess. But very easy items are not desirable in tests, because such items do not discriminate. We analysed Tables 3 and 4 to find out whether students did not resort to wild guessing due to very easy items of the tests. The solid line (———) sets the limit of getting the maximum scores for attempting a given number of items correctly. A large number of cases fal-

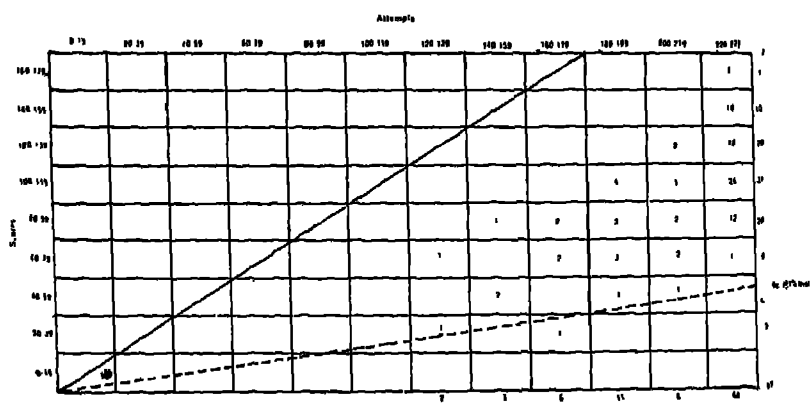

Table 4

Relationship between the number of items attempted and scores obtained on the SECOND objective test.

ling on this line would mean that the test was very easy. It would also mean that the test is primarily a speed test with the scores being determined by the number of items attempted. The farther is the departure of the cases from the line, the more difficult is the test. On

TABLE 5

Topics asked almost every year in the Matriculation/H.S.L.C. examinations

Topics	*Marks allotted in*					
	1966	1965	1964	1963	1962	1961
Drawing a map of India	8	8	8	8	8	8
Rotation and revolution of the earth—their effects	16	16	16	—	16	16+8
Longitude, Latitude, International Date Line; and calculation of time or latitude of a place	16	16	16	16	16	16
Origin, course and use of rivers; and comparison of rivers of south and north India	16	—	16	16	16+8	16
Total	56	40	56	40	64	64
Minimum pass mark	30	30	30	30	30	30

the other hand, a pure power test would have no diagonal values, for in such a test all examinees would attempt all the items; and, therefore, all the frequencies would be in the last column. The Tables show that each test was neither too easy nor too difficult, as a good achievement test ought to be. Thus the argument that students do not resort to wild guessing due to easy items does not hold good in the present case.

As already stated around 80% to 90% examinees were able to complete each objective test. Thus the findings of the present study corroborate the view of Ebel (1965, p. 229) that "Well-motivated examinees who have time to attempt all items, guess blindly on few, if any items."

Essay-Type Tests

The problem of guessing in essay-type tests is quite different

from that in objective tests. In objective tests students guess the right answers, in essay-type tests they guess the question paper itself. The present study embarked upon finding out to what extent students can guess questions and do selective study in essay-type tests. Table 5 gives the results.

The Table shows, that if a student is interested only in passing the examination he can safely confine his studies to the four topics shown in the Table. It may be noted that the marks allotted to the above four topics ranged from 40 to 64 during 1961-66. Obviously anyone who prepares for the above topics can expect a pass in the H.S.L.C. examination in Geography as the minimum mark required for a pass is only 30%.

It is evident from Table 5 that one can completely ignore Geography of India (excepting drawing a map of India, and comparing the rivers of north and South India). He can further ignore topics like types of rocks, mountains, climate, and rain; agents of weathering; glacier; lake; volcano; spring; ocean; ocean current; rainfall, vegetation, and climate of six continents; important towns, ports, industries, occupations, and major commodities exchanged in various countries. Thus, he may practically ignore about 98% of the course and still be certified as having a passing knowledge of Geography.

Discussion

It is evident from the present analysis that almost all the questions asked in traditional essay-type tests in the H.S.L.C. examination of the Secondary Board of Assam in Geography can be converted to objective items. To the extent the question papers under study may be considered typical of the questions set in other secondary boards the findings may be considered relevant to the secondary board examinations of our country. If we convert essay test items to objective items, we shall have several advantages:

At present students spend three hours in answering six essay-type questions. At this rate to answer 76 essay-type questions thirty-eight hours are needed. A student can answer 80-125 items of objective tests per hour. In the present experiment students actually answered 220 objective items in two hours. Thus to answer 470

items, which, as already shown, would practically cover the entire material covered by 76 essay-type questions, students need around 4-6 hours. In other words, an objective test of 4-6 hours would cover what a traditional test of 38 hours covers.

Provision of choice, though not an intrinsic characteristic of essay-type tests, is a universal phenomenon with them. The practice seems to be based on a feeling that students should be given choice to select questions so that they are not penalised due to small sampling of questions in the question paper. Provision of choice in the test is technically objectionable. Stalnaker (1951, p. 505) observes: "When the quality of a carload of wheat is to be determined by sampling the wheat, the buyer does not select fifteen samples and ask the owner which ten he wishes to have used. Such a procedure would be patently absurd.... Yet with essay tests such a procedure is common." Then, provision of choice encourages guessing of the question paper, and confining the study to those questions which would probabily be asked. Due to choice, all the students do not answer the same set of questions. In fact there are hundreds of different ways of combining questions in traditional essay-type question paper. Thus marks in essay-type tests are not directly comparable. Objective tests do not provide choice. The number of items in objective tests is so large that it is least probable to anticipate the items of the test. Even if one does guess in objective tests, it would not profit the guesser, because they cover the entire course. The only way to guess for objective tests is to cover each aspect of the course, and when this is done guessing loses its meaning. Marks on objective tests are directly comparable because all the students take the same test.

Objective tests are useful from disciplinary point of view also. Students often complain that the question paper is difficult. Sometimes the question paper is moderated in the examination hall to satisfy the objections of students. Sometimes another examination is held. This trouble is likely to continue till we have essay-type tests since in these tests there is no satisfactory way to find out in advance the difficulty of the question. In objective tests the difficulty of each question is known before it is publicly used. Hence no one will have a ground to complain against the difficulty of the question paper. In essay-type tests it is difficult to satisfy students of the fairness of marking. In objective tests this problem does not arise at all.

It is sometimes argued that essay-type tests measure higher mental abilities not measurable by objective tests. Whatever little research has been done in this country does not support this view. Studies done by Harper, 1963, and Misra, 1970, indicate that objective tests predict students' achievement in essay-type tests with almost the same accuracy as is obtained from essay-type tests, but more efficiently, i.e. in a shorter time.

It is sometimes said that copying and signalling is very easy in objective tests. This argument comes mostly from those who have no practical experience of administering such tests. In these tests properly motivated students seldom get time to signal or to copy. However, we can take extra-precaution by including some extra items in the test. These items are to be ignored for awarding grades. The procedure would help us to do item analysis of extra items, and select the suitable ones for inclusion in some other tests. This procedure would keep the students busy throughout the testing time. Thus no student would have time to signal or to wait for a signal for copying. Another precaution we can take alongwith the above, is to disturb the serial order of the items in the test booklets. That is, the items do not appear in the same order in the booklets of the students sitting nearby. As such though all the students would answer the same items they would not answer them in the same order. No copying would be possible in this situation. Anyway, the above criticisms of objective tests are hypothetical. It will be unfair to denounce these tests unless these hypotheses are empirically tested.

At present some four months time is spent in examining students and publishing results in the H.S.L.C. examinations. The students sit idle for months waiting for results. Considered on a national level, this is an overwhelming loss of time and energy. If we shift to objective tests, probably the present accuracy of examinations may be obtained in a single day objective testing. However, if we are interested in achieving a much higher reliability, we may need objective tests of still longer duration—say of one hour for each question paper. Anyway, examination would be over within a week, and the results will be announced within a fortnight or so rather than in three months or so. We shall thus have more time saved for teaching and learning, which will surely raise our present standards of education. It may be recalled that the two most widely used matri-

culation examinations of the U.S.A. (the College Entrance Examination, and the American College Testing Program) are administered in only a single day each, and there is no reason to believe that these examinations are less reliable and valid than our matriculation examinations. Even the Britishers who introduced traditional essay-type tests in our country have mostly changed to objective testing in large scale examinations.

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Cross-Lingual Proficiency in Hindi As a Second Language

V. P. Sharma

In a linguistically heterogenous area in the Hindi region, the study has examined the proficiency in writing Hindi among X grade students with different mother-tongues and differing language experiences at school. There are 14 such groups ranging between 33 and 99 in size. Some of the important findings are: students with cognate pairs of languages were found to be slightly superior for orthogonal accuracy and linguistic speed over those with non-cognate pairs, Malayalam among the latter being an exception. Students with Arabic or Persian script in their own language were inferior. Roman script was not found to be such a great stumbling block.

The impact of technological advancement and scientific methods has brought approximately 3000 important languages of the world (R. Lado, 1964) into intensive contact incredibly shrinking the earth. The horizontal social mobility of the people of various races, cultures and languages has intensified the problem of cross-lingual understanding (R. Lado, 1964) and socio-lingual chemistry. The social interactions among the people of diverse cultures create not only the problem of the socio-cultural chemistry, but also of the cross-lingual chemistry. Democracy makes provisions for all in the na-

tional system of education. Under these conditions, the probability of promotion of speech languages is more than non-speech languages. The phonetic characterist and ease-in-learning has popularized Hindi overseas and it has been rated as the third major language of the world (Chatterji, 1945).

The adoption of Hindi as a federal language in accordance with the constitutional rights and privileges as enumerated in the Articles 343-51 of the constitution of India (1948) enhances the importance of teaching and learning of Hindi as a compulsory second language in the national system of secondary education in Indian Union.

Learning new language is acquiring new skills and adapting new linguistic habits. (Fries, 1957, Dunkel, 1948, Chistopherson, 1948, Bloomfield, 1942, Jespherson, 1958).

"A theory of competence purports to be a principled account of the knowledge of the language that an idealized speaker-listener would need to have internalized in order for him to be able to understand and produce any of the infinite possible sentences in his languages. It attempts to account for his 'intuitions' concerning the language, and to 'project' a finite corpus of utterances to a set of rules which assign structural descriptions to the infinite potential of sentences in the language (Chomsky, 1965). A theory of performance accounts for the way in which we put the linguistic capacity to use, and indicate the limitations of the mechanism which expresses the linguistic competence. In estimating the proficiency in the second language, the cubical dimensions of linguistic ability is measured. In addition to the efficiency in motor skill in terms of competence in the speed of writing, the expressional and ideational fluency, and accuracy are also cumulated in the evaluation of linguistic proficiency. To the extent the facilitative factors are present in the teaching-learning process of a second language, the acquisition of the elements of the new language and the linguistic skills are inculcated and promoted. The inhibitory factors present barriers and blocks (Fries, 1957, Palmer, 1953, Morrison, 1958, West, 1960, Penfield and Roberts, 1959) in learning the new language. Fluency, flexibility and accuracy in word and sentence structures play vital role in determining the linguistic proficiency. If the learning of a second language by the non-cognate pairs of language groups creates serious problems of delayed and distorted responses

due to diversity in script and linguistic characteristics between two languages, it also creates the problems of confusion and discrimination for the cognate pairs of language groups due to similarity and proximity in the elements of the two languages (Palmer, 1953, Sharma, 1971). Sharma (1967, 1971, 1972 a.b.e) studied some of the important determinants of scholastic attainments in Hindi. However, cumulated impact of speed and accuracy under mono-frame of reference as measures of scholastic excellence in Hindi as a second language has not yet been explored, though separate studies on speed and accuracy as measures of scholastic attainments in Hindi as a second language have been made (Sharma, 1972 a and b.).

Problems

To examine and estimate the level of (a) cross-lingual orthographical accuracy, and (b) cross-lingual speed in Devanagri script of Hindi as a second language.

Methodology

(a) *Sample*: The various comparable non-Hindi speaking linguistic samples available in west Maharashtra (India) (viz., Marathi, Gujarati, Urdu, Sindhi, Kannad, Punjabi, Bengali, Tamil, Telugu and Malayalam.) could be broadly categorized under five heads:

(a) Linguistic samples with mother-tongue as the medium of instruction viz: Marathi, Gujarati, Urdu, Sindhi (in Arabic and Devanagri Script) and Kannada.

(b) Linguistic samples with Hindi as both mother tongue and medium of instruction, viz: Hindi in West Maharashtra and Madhya Pradesh.

(c) Linguistic sample with Punjabi as mother-tongue and Hindi as a second language and medium of instruction.

(d) Linguistic samples with English as the medium of instruction and the various Indian languages as the mother tongue, viz: Tamil, Telugu, Malayalam and Bengali.

(e) Linguistic samples with English as the medium of instruction and the classical languages like Sanskrit, French, German or Latin as the third language.

For evaluating global written proficiency in Hindi in respect of speed and orthographical accuracy in Hindi at grade X, all the linguistic samples were included in this comparative study.

For the purpose of experimentation the various linguistic samples except the two pupil samples respectively in Maharashtra and Madhya Pradesh with Hindi as their mother tongue and medium of instruction were matched for the period they have received instruction in Hindi as a second language. It has been assumed that the amount of linguistic knowledge, skill, and understanding in Hindi would be more or less equal in the various normative linguistic samples. The Hindi-speaking sample pupils of Maharashtra and Madhya Pradesh were also selected randomly on the strength of the equal periods of instruction they received in Hindi both as mother tongue and as medium of instruction. Since a large number of schools with a large pupil population in various linguistic groups, except in Marathi, was not available in the normative area, the existing schools with desired medium of instruction were selected for experimentation; however, all the normative schools were matched for on the basis of their past three years' S.S.C.E. results. The base line for selection of the schools was 50% average results of the three consecutive years (i.e. 1964-65, -65-66-March Examinations) with a deviation of 10% on either side. All the pupils in the section of a grade X of each of the normative sample schools were taken for experimentation. Tables II summarizes the size of stratified samples.

Verification of nature of Stratified Samples

A pilot study as undertaken to study of the nature of the stratified samples. The indices of skewness of moments of distribution (g1), standard error of moments of distribution (gi) and indices of kurtosis (g2) (Table 1).

All values of kurtosis (g) are 7.263, therefore, the frequency distributions are slightly lepto-kurtic; though not exactly normal which is hardly obtained in any case from field data. Indices of skewness too are not too divergent to make the samples parametric ones. Hence all the stratified samples to a greater extent are representative ones, and therefore, they can not be treated as independent K samples.

TABLE I

Estimates of Indices of Skewness of Distribution (g'_1) *Standard Errors of Moments of Skewness* ($\sigma g'_1$) *and Kurtosis* ($\sigma g'_2$). (*DUBOIS*, 1965, 289-94)

Linguistic Sample	$g'1$	$\sigma g'1$ (5% *limits of Normal Distribution*; $(+1.96 \times \sigma g'1)$	$g'2$
Marathi	+.004	±.680	+.016
Gujarati	—.285	±.621	+.011
Sindhi-Arabic	+.154	±.945	+.013
Sindhi-Devanagri	+.173	±.503	+.015
Urdu	+.181	±.461	+.009
Kannada	+.693	±.707	+.014
Bengali	+.737	±.796	+.016
Tamil	+.402	±.460	+.013
Telugu	—.191	±.711	+.016
Malayalam	+.150	±.766	+.010
Punjabi	+.554	±.635	+.015
Hindi (W.M.)	+.379	±.713	+.026
Hindi (M.P.)	+.301	±.770	+.028

Note: Since all the obtained values of $\sigma g',1$ are well within the 5% limits of confidence of normal distribution, the distributions can be regarded as showing no significant degree of skewness.

Experiment I

Problem: To examine and estimate the level of cross-lingual orthographical accuracy in Hindi of grade X pupils studying Hindi as a compulsory second language.

Material: A Dictation test, comprising of 196 frequent words of Hindi in Devanagri Script.

The most common active but deceptive words invariably misspelt or misunderstood by various samples understudy, were adapted from the written expression of the pupils. These isolated words were, then, composed in the form of a logically connected prose-piece with a view to develop semantic and syntactic consistency. The passage thus developed was circulated to twenty-one teachers of Hindi, at least one from each of the language groups, randomly drawn from the normative secondary schools on the recommendation of the prin-

cipal of the school with respect to sincerity and devotion to duty for evaluating the appropriateness and adequacy of these active words keeping in view their different characteristics, Incorporating the suggestions offered by these teachers, a modified form of the passage was developed. This passage was further, revised, modified, refined, and thus standardized by a pool of first five hierarchically rated moderators of Hindi for the year 1965 at the S.S.C. Examination Board, Poona, actually engaged in the teaching-testing process of Hindi as a second language.

Method

The 'Dictation Test' was tape-recorded under the modulated voice of a native teacher of Hindi. The variations in the pronunciation and articulation of the words dictated were, thus, controlled, and the passage was dictated under optimum controlled conditions to all samples. Provision was made in the auditory presentation of the Test to read out first the entire passage before it was dictated. Each of the words was repeated twice in an interval of 20 seconds to enable the pupils to trace out the missing words. They were instructed specifically to write all the words dictated.

Treatment of the Data

The orthographical errors committed by pupils were counted, and recorded. Measures of central tendency and variability have been computed. Test for significance of mean difference has also been applied for sharp differentiation between pairs of normative samples. Since the treatment of the data was based on the quantum of errors. The higher the mean and median, the lesser the accuracy in written speech.

Result

Among the sample pupils learning Hindi as a second language, the highest limits of errors (Table II) in orthography is attained by pupils with Urdu as their medium of instruction (HL=149) whereas the lowest was observed in case of pupils of Marathi as the medium

TABLE II

Statistical constants of the Orthographical accuracy in Hindi of the pupils at Grade VIII of various language samples

Mother-Tongue	*Medium of Instruction*	*3rd Language Taught*	*N*	*Mean Error*	*Medium*	*SD*	*SEM*	*Range*
Marathi	Marathi	Sanskrit	56	49.30	49.01	16.58	1.35	10-99
Gujarati	Gujarati	Sanskrit	43	56.10	58.00	16.40	2.52	20-89
Urdu	Urdu	Persian	44	98.60	97.00	26.46	4.01	50-149
Kannada	Kannada	Sanskrit	53	49.50	43.60	25.43	3.50	10-119
Sindhi-Arabic	Sindhi-Arabic	Persian	40	58.50	57.50	19.46	3.09	20-119
Bengali	English	Sanskrit	42	43.30	39.50	15.46	2.38	20-89
Telugu	English	Sanskrit	39	43.50	44.50	15.68	2.53	10-79
Tamil	English	Sanskrit	42	47.36	43.25	25.60	3.94	10-129
Malayalam	English	Sanskrit	39	66.50	65.20	26.00	4.20	20-129
Punjabi	Hindi	Punjabi	23	24.50	21.38	16.90	3.52	0-99
Hindi (M.S.)**	Hindi	Sanskrit	47	19.50	18.25	9.89	1.46	0-49
Hindi (M.P.)	Hindi	Sanskrit	45	16.72	15.75	9.38	1.30	0-49

Note : (**) indicate Heterogeneous class-composition, the rest being Homogeneous ones.

of instruction (LL=10) as well as of pupils with Kannada, Telugu, and Tamil as mother tongue (LL=10). The widest range was estimated for Tamil (10-129) whereas the narrowest for Marathi (10-49). The range of errors in respect of Urdu speaking pupils (50-149) is a unique one that characterized errors of extemporization, in orthography.

The highest limit of errors in case of pupils of Hindi as their medium of instruction do not exceed 49. The Punjabi speaking pupils were estimated to have attained a score of 99 as the highest limit of errors. The lowest in all cases in Hindi speaking pupils is zero which reveals that pupils with Hindi as their medium and mother tongue could write accurately many of the word-structures dictated to them whereas pupils other than Hindi as their medium of instruction failed to do so.

A further examination on the basis of mean errors and S.D's (Table: II) reveals that, among the samples, the mean-error in respect of pupils with Urdu as the medium of instruction was the highest (M=98.6), whereas, the lowest mean-error (M=43.3), was estimated in case of pupils with Bengali as their mother tongue and English as their medium of instruction. Even the pupils of cognate pairs of languages e.g. Marathi (M=49.3) and Gujarati (M=56.1) have greater mean error than those of non-cognate pairs, viz: Telugu (M=47.36), Kannada (M=49.5), except of pupils with Malayalam (M=66.5) as mother tongue and English as the medium of instruction. The Sindhi speaking sample Arabic script scored a mean error to the extent of 58.5.

The pupils studying for higher Hindi, have scored lesser mean errors than Hindi medium pupils in West Maharashtra (M=19.5), and Hindi medium pupils in Madhya Pradesh (M=16.72). The level of accuracy of the pupils with Hindi as their mother tongue is certainly superior to those of the pupils studying Hindi as a second language.

Significance of difference in mean errors in writing Hindi in Devanagri Script in respect of the different linguistic samples in terms of critical ratios has been presented in Table III.

Discussion and Interpretation

The superiority of orthographical accuracy of cognate pairs of

Index No of Language groups	1	2	3	4	5	6	7	8	9	10	11	12
1	*	* 1.41	* 1.59	†† 12.69	†† 12.93	†† 19.01	£ 7.57	†† 12.07	£ 8.78	£ 8.67	£ 6.94	†† 10.66
2		*	@ 2.41	†† 12.63	†† 13.91	†† 20.04	£ 8.43	†† 12.82	£ 9.73	£ 9.77	£ 8.17	†† 12.11
3			*	£ 6.09	£ 7.37	†† 12.27	£ 4.24	£ 7.06	£ 4.54	£ 4.45	@@ 3.80	£ 7.23
4				*	* 2.40	†† 15.03	* 0.07	@ 3.01	@ 2.09	* 1.92	£ 0.59	£ 5.09
5					*	£ 9.00	* 1.48	* 0.61	@ 3.51	@@ 3.52	* 1.85	@ 2.20
6						*	£ 9.29	£ 7.78	†† 11.78	†† 11.41	£ 9.34	£ 5.62
7						-	*	* 1.80	* 1.39	* 1.30	* 0.41	@ 3.15
8								*	@@ 3.88	@@ 3.80	@ 2.19	* 1.16
9									*	* 0.06	* 0.88	£ 4.87
10										*	* 0.92	£ 4.86
11											*	@@ 3.35
12												*

Level of Significance
Two Tailed Test :—

(a) * Not Significant (CR less than 1.96)

(b) @ Significant at 5% level (CR 1.96)
(c) @@ Significant at 1% level (CR 2.58)
(d) £ Highly Significant (CR less than 10)
(e) †† Extremely Signicant (CR more than 10)

Remarks —1. Hindi Medium (MS) 2. Hindi Medium (MP) 3 Punjabi 4. Marathi 5. Gujarati 6. Urdu 7. Kannada 8. Sindhi (in Arabic Script) 9. Bengali 10. Telugu 11. Tamil 12. Malayalam.

languages like Marathi and Gujrati over the non-cognate pairs of languages, (viz., Bengali, Tamil, Telugu, Malayalam) could be solely accounted for the facilitative factors like similarity and proximity between the linguistic elements and script characteristics of the two languages. Urdu (cognate in oral speech) and Sindhi (cognate-cum-non-cognate) medium pupils with Arabic Script have exhibited very poor orthographical accuracy which may be due to diversity in the persian characteristic of the Arabic Script. The pupils of non-cognate pairs of languages who learn through English medium in Roman script on the oral speech background of their mother tongue and Sanskrit as a third language have excelled in orthographical accuracy in Hindi over the pupils whose medium of instruction is either Urdu or Sindhi in Arabic script. This finding indicates that Arabic Script is more inhibitory in nature in writing Hindi in Devanagri script than is the Roman script.

The orthographical accuracy in a phonetic language like Hindi is directly governed by the psycho-pedagogically sound and effective methods of teaching the phonetics and phonemes of the second language (Palmer, 1953, West, 1958, 1960, Nelson Brooks, 1960, Belyayev 1963). To the extent, the spot-corrections in Oral and written speech and drilling of structures are lacking in the teaching periods, to that extent orthographical and syntactical inaccuracies enhance. Deviations in pronunciation, articulation, intonation and accent in phonetic languages like Hindi are certainly probing causes of inaccuracy. However, it can not be denied that the orthographical errors in dictation can mainly be accounted for by impact of sound system and word-structures of mother tongues on Hindi. Differentiative and discriminative way of teaching of phonetics and phonemes of Hindi in relation to pupils' mother tongue could bring about an appreciable change in orthographical accuracy in pupils' written speech. Not only could the magnitude and direction of dissimilarity between a pair of languages be treated as inhibitory factors that interferes the orthographical accuracy but even the proximity between the two languages could also be considered as inhibitory factors creating confusions and enlarging the quantum of orthographical errors. The script characteristics of the mother tongue have also a convincing impact on the orthographical accuracy in Hindi.

Conclusions

1. The level of orthographical accuracy in respect of pupils of cognate pairs of languages, was not found very superior to the expectations. On the contrary, it was estimated to be slightly superior to the non-cognate pairs, except in case of Malayalam sample pupils.

2. The non-cognate pairs certainly showed better accuracy in orthographical structures than cognate-cum-non-cognate pairs, viz: Urdu and Sindhi-Arabic.

3. The lowest accuracy in written speech is observed in case of cognate-cum-non-cognate pairs viz. Urdu and Sindhi in Arabic script. The linguistic distance between the cognate or non-cognate and cognate-cum-non-cognate pairs of languages was observed too wide to be bridged.

Experiment II

Problem: To estimate the cross-lingual speed in Devanagri script of the pupils of grade X studying Hindi as a compulsory second language.

Materials and Procedure

The speed in writing Hindi in Devanagri script was measured by a logically connected paragraph of "My School." The subjects were instructed to write as fast as they could for 5 minutes as soon as they get the auditory signal. Since the sample pupils were quite conversant with the topic of the task they have to do, it was assumed that the normative sample pupils would not be handicapped for want of new thoughts and ideas. No insistence was placed on writing only correct sentences.

Analysis of data

The total number of words of the individual subjects written within the scheduled period were recorded for computation of data

regardless of errors by two persons and the average was regarded as the criterion of accomplishment. The speed in writing Hindi in Devanagri script has been estimated in terms of measures of central tendency and variability. Test for significance of mean difference has also been applied for sharp differentiation between pairs of normative samples.

Result: From Table IV, among the sample pupils learning Hindi as a second language, the highest limit in speed of writing is attained by Gujarati pupils (50-1149) whereas the lowest is observed in case of pupils of English medium with French as third language (0-129). The widest range is estimated in case of pupils of English medium with French as third language while the narrowest range is seen in case of pupils of Telugu as mother tongue and English as the medium of instruction (10-49). The range in case of Urdu pupils (0-59) falls too short in comparison to Marathi (50-119) Gujarati (50-149), Sindhi in Arabic script (40-119), Sindhi in Devanagri script (40-129), Tamil (20-119) and English with French as third language (0-129). The accomplishments that could be considered as the highest limits in terms of maximum in speed of writing Hindi in Devanagri script in case of Urdu, Kannada and Telugu linguistic samples are actually the lowest limits in case of other normative samples. The ranges of speed in writing in case of pupils, with Hindi as mother-tongue and medium of instruction in Madhya Pradesh and Maharashtra are respectively (40-159) and (30-149) while in case of Punjabi pupils, with Hindi as the medium of instruction, it is (40-109).

A further examination on the basis of mean speed and S.D. (Table IV) reveals that among the pupils studying Hindi as a second language, the highest mean is attained by the pupils of Sindhi medium with Devanagri script (M=87.3) whereas the lowest mean is scored by the pupils with Urdu as the medium of instruction (M=33.00). The pupils of cognate pairs i.e. Marathi (M=86.2) and Gujarati (M=82.05) also fail to surpass the pupils of Sindhi medium in Devanagri Script. The speed in writing of pupils of noncognate pairs fall considerably short of those of cognate pairs, for example, the mean speed of Bengali-medium pupils is 55.5, of Telugu-medium pupils 55.6, of Tamil and Malayalam-medium pupils 63.8, of English medium pupils with French as third language 56.1

TABLE IV

Statistical constants showing the speed of writing Hindi in Devanagri script of the various language groups at Grade X in the Secondary Schools of West Maharashtra.

Mother-Tongue	*Medium of Instruction*	*3rd Language Taught*	*N*	*Mean*	*Median*	*S.D.*	*S.EM*	*Range*
Marathi	Marathi	Sanskrit	46	86.20	83.25	16.34	2.40	50-119
Gujarati	Gujarati	Sanskrit	49	82.05	79.14	17.00	2.43	50-149
Urdu	Urdu	Persian	39	33.00	35.00	13.56	2.19	0-59
Kannada	Kannada	Sanskrit	48	55.75	54.96	19.69	2.85	10-69
Sindhi	Sindhi-Arabic	Persian/Sanskrit	36	67.00	66.50	15.70	2.60	40-119
Sindhi	Sindhi-Devanagri	-do-	46	87.30	86.50	20.49	3.01	40-129
Bengali	English	Sanskrit	41	55.50	52.50	66.67	2.60	20-89
Telugu	-do-	-do-	27	55.60	53.60	18.30	3.52	10-49
Tamil & Malayalam	-do-	-do-	44	63.80	62.83	22.69	3.44	20-119
Heterogenous††	-do-	French	43	56.10	49.00	25.19	3.81	0-129
-do-	-do-	German/Latin	38	62.10	64.90	16.40	2.64	20-99
Punjabi	Hindi	Punjabi	33	76.30	76.50	18.30	3.21	40-109
Hindi (M.P.)	-do-	Sanskrit	99	97.94	100.69	22.95	2.31	40-159
Hindi (W.M.)††	-do-	-do-	86	96.70	89.00	22.69	2.44	30-149

Note :—(††) indicates Heterogeneous samples, the rest being Homogeneous ones.

and of English medium pupils, with German-Latin as third language (selective admission) is 62 1. Even the sample Punjabi pupils (M=76.3) do not surpass the pupils, of cognate pairs of languages i.e. Marathi (M=86.2) and Gujarati (M=82.05). The mean speed in writing of the sample Hindi medium pupils either in Madhya Pradesh (M=97.94) or in West Maharashtra (M=96.7) is significantly greater in comparison to all other normative samples studying Hindi as a compulsory second language.

The significance of difference in mean speeds in writing Hindi in Devanagri Script in respect of the different linguistics samples in terms of critical ratios is presented in Table V.

Discussion -

The probable reason that could be advanced to the superiority in speed in writing of the pupils of Sindhi medium in Devanagri Script is that Devanagri script facilities the pupils with Sindhi as the medium of instruction written in Devanagri script not only while learning Hindi and Sindhi but also while learning all other subjects. It appears that there is least interference in learning Hindi in case of pupils of Sindhi-medium with Devanagri Script in comparison to other normative samples. Dr. Trumpp (1872) might have rightly visualized when he remarked, "The Sindhi is a pure Sanskritical language, more free from Foreign elements than any other of north Indian Vernaculars. It is much more closely related to the old Prakrit than the Marathi, Hindi, Punjabi and Bengali of our days". To the pupils of cognate pairs of languages like Marathi and Gujrati, learning of Hindi as a second language certainly assures some more facilitative factors in comparison to non-cognate pairs of languages like Bengali, Tamil, Telugu or Malayalam. Even then, it can not be denied that proximity and similarity of word, sentence and syntactical patterns between the cognate pairs of languages also interfere with the speed of learning the other language. The pupils of cognate-cum-non-cognate pairs of languages like Urdu and Sindhi in Arabic script suffer severely not only because of the diverse characteristics of the Arabic script but also because of too similar word and sentence structures. If the pupils fail to develop sharp discriminative capacity between the two language patterns

TABLE V

Evaluation of difference in mean speed in writing Hindi at Grade & by Pupil of different media or instruction and mother tongue in terms of critical ratios

Index No. / *Language groups*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	*Remarks (Sample groups)*
1	†	† 1.24	†† 17.6	£ 9.10	£ 5.35	† 0.30	£ 9.30	£ 7.20	£ 5.41	£ 6.84	£ 6.75	@ 2.48	@@ 2.84	@@ 3.17	1. Marathi
2		†	†† 14.64	£ 7.01	£ 4.18	† 1.36	£ 7.42	£ 8.04	£ 4.21	£ 5.91	£ 5.58	† 1.30	@@ 3.95	£ 4.29	2. Gujaratı
3			†	£ 6.21	†† 10.06	†† 14.10	£ 6.62	£ 5.84	£ 7.44	£ 4.87	£ 8.48	†† 11.54	†† 16.33	†† 16.61	3. Urdu
4				†	@@ 2.82	£ 7.60	† 0.06	† 0.03	† 1.76	† 0.07	† 1.60	£ 4.73	†† 10.50	†† 10.60	4. Kannada
5					†	£ 4.91	@@ 3.06	@@ 2.67	† 0.77	@ 2.26	† 1.31	@ 2.13	£ 7.21	£ 7.52	5. Sindhi-Arabic
6						†	£ 8.03	†† 11.52	£ 4.79	£ 6.44	£ 6.14	@ 2.56	@ 2.39	@@ 2.70	6. Sindhi-Devanagri
7							†	† 0.02	@ 2.00	† 0.01	† 1.82	£ 5.71	†† 10.49	†† 11.14	7. Bengali
8								†	† 1.90	† 0.01	† 1.50	£ 4.27	£ 8.41	£ 9.21	8. Telugu
9									†	† 1.51	† 0.38	@@ 2.89	£ 7.89	£ 8.36	9. Tamil and Malayalam
10										†	† 1.27	£ 4.95	£ 9.23	£ 9.71	10. English-French
11											†	£ 3.42	£ 8.54	£ 8.98	11. English-Latin & German
12												†	£ 4.71	£ 4.95	12. Punjabi
13													†	† 0.33	13. Hindi Medium (MS)
14														†	14. Hindı Medium (MP)

Level of Significance :—

(a) † Not Significant (CR less than 1.96)
(b) @ Significant at 5% level (CR 1.96)
(c) @@ Significant at 1% level (CR 2.58)
(d) £ Highly Significant (CR less than 10)
(e) †† Extremely Significant (CR more than 10)

under study, then each one of them interferes with the progress of the other. The comparative data of Sindhi as mother tongue reveals that Devanagri script facilities the learning of Hindi whereas Arabic script adversely affects the learning. Even Roman Script is not so inhibitory as the Arabic script in learning Hindi. The results reveal that the speed in writing Hindi in Devanagri script by various linguistic samples is directly related to the similarity and proximity of the script of that particular language groups to Devanagri script. Obviously the means and ranges in speed of writing of the pupils studying Hindi as their mother-tongue and medium of instruction are characteristically higher than of those pupils who are studying Hindi as compulsory second language.

Conclusions :

The main findings of this study are:—

(1) Pupils of cognate pairs of languages, *i.e.*, Marathi and Gujarati are found remarkably faster in speed in comparison to both non-cognate, i.e., Bengali, Tamil, Telugu, Malayalam and Kannada, and cognate-cum-non-cognate pairs of languages like Urdu and Sindhi in Arabic script. The speed of cognate-cum-non-cognate pairs of languages was found shockingly inferior to the other two pairs of languages.

(2) On a scale of speed, among those studying Hindi as a second language, the pupils with Sindhi as medium of instruction in Devanagri script were found on par in comparison to other language groups and even to cognate pairs of languages whereas pupils with Urdu as their mother tongue and medium of instruction were the slowest on the scale.

(3) Pupils with Sindhi in Devanagri script as their medium of instruction were found suprisingly superior to pupils with Sindhi in Arabic script. This finding certainly supports the feasibility of adopting Devanagri script in the teaching and learning of other Indian languages. Arabic script is a greater handicap to the pupils in writing Hindi swiftly as compared to Roman or Devanagri or even Kannada.

(4) The speed of writing Hindi in Devanagri Script by pupils with English as their medium of instruction in Roman script that is non-cognate pairs of languages falls in between the pupils who have adopted either Devanagri or Arabic for expression.

(5) Pupils of non-cognate pairs of languages (with Sanskrit as third language) like Bengali, Tamil, Malayalam and Telugu with English as medium of instruction in Roman Script and with the background of mother tongue in a homogeneous class-room are far superior to those pupils of English medium schools who offer the foreign classical languages as third language in a heterogeneous class-room.

(6) Pupils studying Hindi as their mother-tongue have shown, as expected, significant superiority in speed of writing in comparison to all normative linguistic samples studying Hindi as a compulsory second language.

General Evaluation of Proficiency In Hindi As a Second Language

A clear perception of proficiency in Hindi can be had in respect of the comparable groups by taking into consideration a cumulative account and evaluation of the degree of accuracy as well as the speed of writing.

The inferences are:

(1) The pupils with Urdu as the medium of instruction were the weakest not only in accuracy but also in the speed of writing Hindi.

(2) The Sindhi medium pupils with Devanagri script were found superior not only to those with Sindhi medium in Arabic script but also on par in speed of writing Hindi to most of the cognate pairs of languages.

(3) The pupils with cognate pairs of languages were found slightly superior in orthographical accuracy and linguistic speed in writing Hindi to those of non-cognate pairs, except to Malayalam as well as to those of cognate-cum-non-cognate pairs.

(4) The Roman script was not found so great a stumbling block for the pupils in learning Hindi with accuracy and speed, as the Arabic script. The Devanagri script, if introduced in lieu of Arabic Script as the medium of instruction showed remarkable facilitative effect as has been observed in case of pupils with Sindhi as the medium of instruction in Devanagri script. Similarly, the Kannada script or the South Indian scripts were also not so helpful to the pupils in writing Hindi with speed.

(5) The speed and accuracy of writing Hindi of the pupils with Hindi as their medium of instruction were found far superior to these who study Hindi as a compulsory second language. Even the sample Punjabi pupils who had adopted Hindi as the medium of instruction, showed better accuracy than those of cognate pairs of languages; however, the former samples lagged behind the latter in the speed of writing.

(6) The accuracy and speed in writing Hindi of the pupils of Bengali, Telugu, Tamil and Malayalam as mother tongue but English as the medium of instruction, were found superior to those English medium pupils who have offered French, Latin or German as a third language. The pupils with Kannada as mother tongue as well as medium of instruction were also found as proficient in orthographical accuracy as the cognate pairs. However, they lagged far behind in the speed of writing Hindi. This reveals a facilitative effect of Sanskrit as a third language but in inhibitory effect of Kannad script.

General Discussion

The alarming inaccuracies in orthography in case of cognate pairs of languages could be accounted for the ineffective teaching of phonetics and phonemes. Absence of conscious and automatic language habit accelerated the inaccuracies and obstructed the speed of writing Hindi.

A proficient writer is one who is accurate and swift in writing the language. In view of the results, it is apparent that the cognate

pairs lacked behind in accuracy while the non-cognate pairs could not write as swiftly as the cognate pairs. This may be attributed to the interference arising due to similarity in word-structures between the cognate pairs in case of orthographical accuracy whereas in case of speed of writing perhaps, the anti-character of script in comparison to Devanagri script may have the inhibitory effect on the pupils of non-cognate pairs of languages.

In order to have an insightful perception for the orthographical accuracy in the language under-study, it is essential that the orthographical and syntactical errors of the various linguistic pupils should be systematically analysed with a view to bring about a qualitative improvement in the teaching-learning and testing processes.

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BOOK REVIEWS

Modern Management Techniques in Educational Administration

Report of the Regional Seminar on the application of Modern Management Techniques to Educational Administration.
Asian Institute of Educational Planning and Administration, New Delhi 1971, pp. i-ii+542, Price—not mentioned.

The present publication is the report of regional seminar on the title of the book held from November 2 to 12, 1970 as part of the celebrations of the International Education Year. The objectives of the seminar were:

—to acquaint educational administrators and planners with the theory and concepts of modern management;
—to make them aware of the application of some of the modern management techniques to administration in general and educational administration in particular;
—to create an appreciation in the minds of educational administrators for trying out some of these techniques in the field of educational management; and
—to promote studies and research in the application of modern management techniques to educational administration, particularly in the developing countries of the Asian region.

The seminar was attended by delegates from nine countries of the Asian region such as Afghanistan, Japan, Indonesia, Republic of Vietnam etc. Supported by Unesco and the Indian Commission for Cooperation with Unesco, the seminar started on a happy note of giving a purposive direction to the maintenance administration and revamp it as development administration.

The publication is divided into two parts. The first being the report, conclusions, recommendations and a few annexures such as the key note address of Prof. M. V. Mathur, presidential address of Dr. D. S. Kothari and the valedictory address of Mr. K. T. Chandy. The second part carries the full text of discussion papers and also a selected bibliography in Modern Management Techniques as applied to Educational Planning and Administration. Not unlike any other

published report both parts of the report are equally important i.e. the discussion and the discussed papers—the only thing is that one should read part two first and part one next.

The key note of the seminar appeared to be the assumption that education is also some kind of a business and, therefore, improved techniques of business management should be applied to it for bringing about better results. Further, it also implied that there are a few 'improved' techniques in existence and that 'efficiency' and 'streamlining' are to be the basic ingredients of modern educational administration as well. Since educational administrators are also entitled to their opinion and outlook one need not question the validity of their assumptions because once we start asking questions there will perhaps be a short supply of ready made answers. Here one is expected to forget that 'efficiency', 'products', 'economy' etc., are the reflection of the degree of national prosperity a society has reached opting out for the machine as the model of human endeavour and that these are not inherent in a social order. Consequently, they can be woven into the texture of education only when society starts visualising education as a pure business proposition and drops down all its cultural and spiritual contents. So long as this is not done the application of business techniques to educational administration would enjoy a rather dubious honour of being out of the spirit of the whole thing.

Be that as it may, we may start off with the three speeches that were delivered by Shri M. V. Mathur, Dr. D. S. Kothari, and Shri K.T. Chandy, Chairman, then Hindustan Steels (and now a member of the University Grants Commission). As Prof. Mathur was awed by the enormity of numbers involved in the learning-teaching process, say around 75 million of them, he wished to focus our attention to the existing need "to concentrate on the development of a strong management force to guide it". Education appeared to him, "the most rapidly expanding labour—intensive activity". Therefore one is not surprised at the reason why he wanted management techniques to be applied to educational administration. Dr. D. S. Kothari in his presidential address struck another note. For him education is a highly competitive activity and needed commitment on the part of those engaged in it. He differentiated the management of factory from that of education and cautioned that "one way of management

may not be intrinsically better than the other way of management''. In fact, he stressed his point by stating ''it will be quite apparent that we cannot transfer the techniques of management and so on from other fields, and yet we must learn from these techniques and underscore the value and importance of a seminar like this''. Shri Chandy joined issue with Prof. Kothari and held, ''I have a feeling that somewhere at the back of his (Kothari's) mind there might have been a notion that these techniques are coloured by the economic objectives of business by profit and so on. May I say that these methods have nothing to do with our objectives''. He also pointed out that these are analytical methods being made applicable to all manner of situations irrespective of value patterns inherent to these situations. ''So, I would say that the academician ought to bring to his own problems the contribution of his own working in the field of behavioural sciences, mathematics and economics and in so doing, let him not be prejudiced by the fact that these were first applied in the world of economic activity.''

These three distinguished persons reflected in their addresses a wide spectrum of opinions vis-a-vis the theme of the seminar. It should not be strange for anyone to note that a fair amount of scepticism is only too endemic to the problem. One may however be surprised at the enthusiasm of the seminarians who had already accepted the need and suitability of the application of management techniques to educational administration and these techniques range from systems analysis, OR to PPBS. They hardly paused to reflect whether education was amenable to these techniques and whether the objectives and the end products of education did not constitute cultural 'goods' and were therefore outside the purview of any profit motive and computable efficiency and effectiveness.

Opinions apart the papers read out at the seminar and appended in the report are both imaginative, scholarly and technically useful. Papers like Key Variables in Organisation Study (Prof. Ishwar Dayal); Impact of the Behavioural Sciences and Administration (Sr. Professor Nitish R. De); Introduction to Operations Research (Prof. J. N. Kapur); Applications of PERT/CPM to Educational Programmes and Seminar (Bharat B. Shah); Performance Budgeting and PPBS (M. J. K. Thavaraj); Use of Computers in Education (Dr. A. B. L. Srivastava) etc. are extremely useful. Prof. De raises

the most crucial issue in regard to the orientation of administration where he says it is *status quo*-oriented in a developing country. Prof. Dayal wants a redefinition of the task system for achieving success and holds that "the structure of an organisation and the division of its activities, its authority relationships should relate intrinsically to the task to be done". In other words, both these professors only state a theoretical possibility of bringing about changes provided redefinition of the task system is done and the nature of the administration of developing societies is understood properly.

These are introductory papers to several techniques being used in the Management of organisation and a direction is indicated for educational administration to follow the suit. Experiences of other countries are also provided in the form of papers for experts to look up. For a good discussion of the entire issue on a layman's plane, one may like to look up the paper by the UNESCO expert Dr. Anand W. P. Gurage.

Beautifully brought out and being highly instructive, the present report should be a must for all those engaged in the task of administering education. One hopes that some thinking on this issue will be initiated by organisations like the NCERT and the SIEs.

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Research in Geography

A Survey of Research in Geography.
Sponsored by the Indian Council of Social Science Research, New Delhi,
Published by : Popular Prakashan, Bombay. (pp. 397, Rs. 30).

This four-hundred page volume brought out under the auspicies of the Indian Council of Social Science Research, New Delhi and published by Popular Prakashan, Bombay, is second in the series planned by the Council. The main idea of conducting this survey is to take stock of the work done so far and to formulate priorities and significant programmes, in order to, promote social science research in our country. Geography is one of the seven areas selected from the broad field of social sciences.

The survey of research in geography has been confined only to the social aspect of geography and not the physical, obviously keeping in view the area of concern of the ICSSR.

The findings of this survey have been classified under the broad heads such as Economic Geography, Historical Geography, Human Geography, Political Geography and Regional Geography. In addition, the applied areas such as Geography and Planning, Methods of Geography and Training in Research Methodology have also found special place in this scheme.

Within the above mentioned broad areas certain specific topics such as Land Use Studies, Forest Resources Geography, Industrial Complexes, Metropolitan Planning, Regionalism and Regional Planning, River Valley Development Planning, Geography of Rural Settlements, Medical Geography, Air Photo-Interpretation, Quantative Methods in Indian Geography and Thematic Mapping have also found a prominent place. This should indicate the comprehensive nature of this survey.

There are in all twenty-five sub-areas included in this survey. Each one of them was assigned to a competent person in the area concerned. The general approach adopted in this "quick" survey completed in less than two years time, was to prepare a comprehensive bibliography of various research papers published mainly "by the Indian Geographers and on Indian problems." On the basis of a quick review of these research articles or papers published in various

journals a brief "trend report" was also prepared to precede each bibliography. The last section gives a summary of recommendations in each of the twenty-five sub-areas selected for this survey.

The wide coverage and approach adopted in conducting this survey and the eminent geographers in the field who have been associated with this work should by themselves indicate the usefulness of this laudable task. It should not be out of place if one has again only to re-echo the feelings of the Chairman of the Indian Council of Social Science Research that "there should be no doubt that the entire academic community of teachers and students in social science will remain ever grateful to these people" who have gladly undertaken this task and cheerfully completed it.

It has been estimated that about 1,000 students receive their Master's degrees in Geography every year and 20 candidates receive their doctorate in the subject. It would certainly be a great help to all the students and teachers of geography who would undertake or guide research work in this subject. The survey in itself would be of great help to every Post Graduate Department of Geography for the selection of topics of dissertation and doctoral thesis since it would help them to know what areas have already been covered and what gaps still remain to be bridged. In fact, the survey has only mapped or plotted what has been attempted so far without possibly going into merits of each piece of research. In this sense it is only a beginning and much would now depend upon further detailed analysis and intensive qualitative assessment of the researches conducted so far, the gaps that have been left out and the critical areas and the problems that merit immediate and serious attention of the scholars.

Very often research in our country remains some kind of a ritual or a routine that has to be resorted to not for its own sake but merely as a key to open up better monetary or social status prospects. It is no wonder, therefore, that in spite of a fairly good amount of work that has been put in by our geographers we have yet to acknowledge what Prof. Moonis Raza describes as Indian "geography tended to develop at best as a *dinosaur* with huge body, a long tail and the tiny little head," and if this 'spongy organism without a theoretical spine' has to obtain a personality or an individuality of its own, certainly it must acquire Indian character not in the chauvinistic sense but in terms of identifying our problems, and tackling them in the context

of our present socio-economic and technological frame work, so that the best brains among the younger generations are attracted to accept this challenge irrespective of any monetary or other considerations.

It is hoped that the present survey will serve its purpose if the next steps are followed, in this broad context and from this wider perspective, focussing our attention in making geographical research in our country an organism that would stand on its own legs and locate, identify and delimit topics from this entirely Indian point of view combining realism and a needed degree of conviction coupled with a certain amount of idealism.

It would be in our own interest to bid goodbye to the concept of dovetailing Indian researches to the cliches and perspectives of the industrially advanced countries, and our habit of looking for acknowledgement only, outside our own country. It should be our legitimate ambition to locate and tackle problems that would challenge even the scholars from outside who would make special efforts on their part to view the solutions of the problems from the Indian point of view.

The Indian Council of Social Science Research as well as the Indian geographers deserve our thanks and gratitude for the good work they have completed so promptly and in a record time. Let us pray that the joint efforts of the ICSSR and of the Indian georgraphers would also succeed in correcting our bearings and focussing our attention on those problems which would ultimately result in bringing better tomorrow for toiling and illiterate millions of our brethren.

It may perhaps not be out of place to mention the present effort would remain incomplete till similar survey is undertaken in the area of physical geography as well. It is a known fact that the study of geography would be incomplete till both the fundamental aspects—physical and human—are properly correlated and synthesised.

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Concept Formation in Children

Children's Classification Skills
Mary Nixon, Australian Council for Educational Research, Victoria, 1971 (pp. 107).

The study under review has received inspiration from the work of three men, who have provided the ways of looking at the field, methods of studying it, and stimulation to push a little further along the track which may one day lead us to an understanding of human thinking. These men are Lev Semenovich Vygotsky, who died of tuberculosis in 1934, Jean Piaget, well on in years but still at work in Geneva, and Jerome Brunner, leader of a busy team of researchers at Harvard University in Massachusetts, U.S.A.

Dr. Mary Nixon, author of the book is a senior lecturer in psychology in the education faculty at Monash University in Australia. The work reported here began as one of the research projects of the Australian Council of Educational Research. It is presented in a very simple and lucid form in the hope that it will be of interest and use to teachers, to students and lecturers in teachers' colleges and university schools of education, to the rapidly increasing number of informed parents of young children, and to all who are fascinated and puzzled by the changing patterns of intellectual skills that are observable in children's behaviour.

The purpose of this study was to formulate some of the rules that people use to group things, and to find out how well young children could use them. Grouping, classifying, and labelling have been recognized for a long time as being the main processes by which people organize what they hear and see and touch. They are the processes through which people are able to make judgements about what is going on around them, and are therefore, the foundations of thinking. However, the book does not go into details to describe the theoretical examinations and experimental investigations which over many years have added to our understanding of thinking, judging, problem solving, putting things in new forms, and the like.

The study was designed to answer the following questions:

How accurately and consistently can children use rules about grouping?

How does their ability to use these rules change with age?

Do girls differ from boys consistently and meaningfully in the ways they use rules about grouping?

A further aspect of the study was concerned with how well children could explain verbally and justify the groupings they made.

Five classification tasks were devised to answer these questions. Each task used a particular set of rules, and consisted of six items. The material for sorting and grouping consisted of rods and blocks of different sizes, shapes, and colours.

The following tasks were devised:

(1) The Matching Task
(2) The Cross-Classification Task
(3) The Seriation Task
(4) The Equivalence Task and
(5) The Hierarchical Task.

As mentioned above, tasks had to be constructed and presented in each a way that the solution could be obtained by applying one, and only one, set of rules in each task. It would be too optimistic to claim that author was able to achieve that, though she directed her effort towards planning tasks for which only one solution could be logically considered 'Correct'.

The children who took part in the study were pupils at sixteen Victorian State Planning Schools in the Melbourne metropolitan area. The schools covered a wide geographic area, from north to south and from east to west, and included inner city as well as industrial and residential suburban areas.

Altogether, the tasks were given individually to 612 children, whose ages ranged from 5 to 10 years. Half were boys and half were girls. In a preliminary study children at fifteen of the schools were tested primarily to find out two things: (1) whether the tasks had a range of difficulty such that children of different ages would find them easy enough to attempt but hard enough to be challenging; and (2) whether performance varied from school to school.

The main part of the study was carried out at the sixteenth school belonging to a middle class residential suburb where 180 children each attempted every one of the five tasks. Children with a language background other than English were excluded from the sample.

The order in which the tasks have been described is a rough indication of their difficulty. The first one described as the Matching Task, was the easiest when grouping was scored (Right only R), the second one, the Cross-classification Task, was easiest when the explanation was also scored (Response+Explanation—R+E) ; the Equivalence and Hierarchical Tasks were consistently difficult.

The results show a fairly steady decrease for each age group in the percentage of correct responses over the four tasks. It was seen that children could use the rules required for the Matching Task and the Cross-classification Task fairly consistently and accurately. However, not until 9 years of age could children do even moderately well with the rules required for the Seriation and Equivalence Tasks. So the answer to the first question is that when the rules are fairly simple, even young children can apply them; as they become more difficult and complex, children as old as 9 years may still have considerable difficulty with them.

To find out how abilities change with age, one may give the same tasks to the same children at different ages, or choose groups of children of different ages and compare their performances on the same tasks.

This study used the second procedure. In every case, older children performed better, although the changes did not, for individual pairs of mean scores, always satisfy a criterion of statistical significance. (The criterion used was p 0 01, for 't' tests). Nevertheless the almost uninterrupted increase with age in percentages correct for both sexes, on every task, is powerful evidence that children get smarter at applying rules about grouping as they get older. This is not likely to surprise anyone. But a couple of reservations should be made. In the first place, simply getting older is unlikely to make children, smarter unless they have opportunities to use rules and to find out whether they work; that is, they need plenty of practice and plenty of feedback about their performance for their use of rules to improve. Secondly, improvement with age was not quite regular, there was a marked improvement from 5 to 7 years, but in most cases improvement from 7 to 9 years was relatively slight. It is quite likely that the kinds of rules which children can learn to use from 7 to 9 years of age depend on the rules that they have learned

before, and that some of the rules require skills and abilities that very few children younger than 7 years have been able to master.

The differences between boys and girls were greater at 5 and 7 years than at 9: if there were real differences, they appear to be decreasing by 9 years, as though the boys were catching up. However, the 9 year-old-boys may have been a better group of children than the 5 and 7 year old boys; had the same children performed the tasks at the three ages, this possibility would have been controlled.

The aim of the study was to throw some additional light on general language abilities. This aim was not fully realized. The difficulty was in using a criterion for judging whether a verbal account was correct or not. In the Matching and Cross-classification Tasks, the children had to describe the colour, height, diameter, or shape of the rods or blocks that they have chosen or arranged. For the Seriation Task, the criterion was description of a single attribute—height or diameter. For the Equivalence Task, also, the criterion for a satisfactory explanation was low, relative to the skill required for grouping the rods, since mention and indication of two attributes relevant to solution was all that was required. The reason, for adopting a low criterion was that children were quite unable to verbalize a relationship of this kind, which was what the task really required. The Hierarchical Task called for a verbal response only: criteria for correctness were therefore high and strict. As a result this task appeared to be very difficult, especially for the 5 and 7 year olds, and more so for the boys of these ages.

One thing emerges clearly from this: the children were much more competent at applying the rules about grouping than they were at explaining them, though the discrepancies between grouping and explanation were much smaller at 9 years than at 5 years of age. The language system seemed to be 'catching up' with the concrete operations.

Some persistent patterns of explanation deserve mention which the study brings forth. Children found it difficult to deal with more than one attribute at a time, though they could operate in terms of a single attribute quite consistently. In the Seriation Task, even the best descriptions did not so much integrate the two attributes (height and diameter) in the matrix items, as describe each one separately. In the Equivalence Task the failure to express a

relationship was shown in a similar way. When ordering broke down, as it often did in both of these tasks, the descriptions tended to be enumerations of single units, with little justification offered for the arrangements the children had produced. The Hierarchical Task produced another manifestation of inability to operate simultaneously with more than one attribute: instead of reporting that one class included the other, children treated the two classes as mutually exclusive co-ordinate groups, failing to express the relationship that held between them.

The crux of the problem is that, for a relationship to be described, at least two attributes have to be juggled mentally and verbally, and the only complex relationship these children could reliably express was that of mutual exclusion, as in the Cross-classification Task. The Seriation, Equivalence, and Hierarchical Tasks involve relationships operating between attributes on more than one dimension; while considerable numbers of children could build up appropriate groupings, operating in terms of consistent rules, their language systems were not sufficiently co-ordinated with the operations to enable them to explain the groupings as well. In very rough terms, this means that they can do things before they can say them. Language develops more slowly than manipulation. This, however, points to a research area which needs to be explored. It does not suggest what the answers are.

At the beginning of this review, three men were described as having made special contributions to knowledge of human thinking: Vygosky, Piaget, and Bruner. The Piagetion work to which the present study is most relevant is *The Early Growth of Logic in the Child: Classification and Seriation* by Inhelder and Piaget, which was first published in English in 1964. Also Bruner and others (1966) methods for investigating seriation were adapted for this study. Like Piaget, he suggests that children develop through a series of stages; like Piaget, he argues that thinking and language gradually become linked, although they develop separately during early life. While there is little direct link between Vygotsky's theorizing and the results of the present study, classification skills were ahead of language skills, young children handled and talked about the rods and blocks more than the older ones, and even the 9-year-olds still had a long way to go in learning rules for thinking. In

Bruner's view, too, a child's skills and abilities with language directly influence what he can do with things around him. The Seriation Task directly tested Bruner's contention that language and seriation skills are closely linked. No relation of the kind that Bruner and Kenny found appeared in the results of the present study.

In conclusion, it will be quite pertinent to focus the ways in which readers may take advantage of the work reported here. The description of the characteristic way of childrens' grouping may help those who work with children to make their observations more perceptive, and may even suggest new things that they might look for. Everyone who has worked with young children knows that they can recognize similarities and differences, but get exasperated, by the limited and often literal use that children make of similarities and differences in grouping and manipulating the things around them. Some people may be reassured to find out that this is to be expected, and that children eventually learn to restructure their groupings to take in the attributes which are appropriate in different situations. However, they need proper instruction and proper practice to enable them to do so.

Secondly, this study proposes a general principle that children could accurately group, match and order objects before they had sufficient grasp of language to explain what they had done, and why. A greater awareness on the part of teachers and parents of the discrepancy between action and language in young children may stimulate production of programmes of instruction which will attempt to minimize the effects of the discrepancy in a realistic fashion. The aim of such programmes might be to increase and differentiate the action skills and at the same time to provide linguistic stimulation and practice in linguistic skills under conditions in which children receive plenty of feedback.

This study has confirmed the previous findings relating to the difficulty young children have in simultaneously taking several attributes into consideration to achieve a satisfactory solution. One would expect that as the symbolic systems of language become more mature and versatile through the first dozen or 50 years of life, so children will become better able to represent and manipulate several attributes in the situations with which they have to work. Some precise dynamic formulation is needed. It opens a field for the re-

search worker. Some tasks, in particular, can be used for further work e.g. the Cross-classification Task, the Seriation Task. Much remains, however, to be done in exploring the dimensions of human thinking which are included in intellectual development.

U. K. BEVLI

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Evaluation of Student Learning

Handbook on Formative and Summative Evaluation of Student Learning

Bloom, B.S. ; Hastings, J.T. ; Madaus, G.F., McGraw-Hill Book Company, 1971 (pp. 923)

The handbook is the latest of the treatizes in educational evaluation and probably the most comprehensive one so far brought out in this field. There have been several publications on the subject but probably not handbooks. It is a unique beginning in this regard.

It has two parts—part 1 consists of four sections and deals with the problems, teachers could face in their efforts at attempting evaluation of pupil achievements. The first section in this part is entitled as "Education and Evaluation". The three chapters of this section present a point of view and an approach to education, the ways of functionally defining educational objectives and the methods of improving the level of achievement of pupils through evaluation.

The second section which again has three chapters is entitled as "Using Evaluation for Instructional Decisions". This section introduces two comparatively new concepts of formative evaluation and summative evaluation. The section thus endeavours to identify wider uses of test results for purposes not only of grading, classification and certification, but also emphatically presents an argument for diagnosis, remedial instruction and guidance. This section has a special teacher appeal because of the ideas it provides for the improvement of teaching and learning through the instrumentality of effective evaluation procedures.

The section three is captioned as "Evaluation Techniques for Cognative and Affective Objectives" and contains four chapters. For dealing with the techniques of evaluation, 'knowledge and comprehension' have been clubbed together and so also 'application and analysis', and 'synthesis and evaluation'. Evaluation techniques for affective objectives have been dealt with in a separate chapter. The entire section has been woven around the "Taxonomy of Educational Objectives" (Bloom, 1956; Krathwohl, 1964). The models

contained in this section regarding the selection of techniques and the development of tools for the evaluation of different objectives are likely to be of great interest to the educational practioners.

The fourth section which is entitled as "Evaluation Systems" has two chapters dealing with the methods by which the work-load of teachers and experts in the area of educational evaluation can be reduced through a co-operative effort. Besides, this one of the chapters gives a birds' eye view of some of the new major developments in this area.

Part 2 of the book consists of 11 chapters—two of which are devoted to the evaluation of learning in pre-school education and the rest on evaluation in major subject fields. Specific discussions on latest evaluation procedures and practices in Language Arts, Social Studies, Art Education, Science, School Mathematics, Literature, Writing, Second Language and Industrial Education evidently make the coverage of this part of the handbook as comprehensive as it is of the first one.

The handbook has been brought out by three eminent educationists who have contributed the first part and edited the second which has been developed by other stalwarts in their respective fields.

Critical Estimate

Though not meant to be read from cover to cover, the handbook is likely to be of profitable use to the teacher, the curriculum maker, the test constructor and the students of curriculum and evaluation all alike. For the teachers it is full of ideas and examples for using evaluation in the improvement of teaching and learning. The curriculum specialists can find in it a treasure of already identified (with great labour) content and ability specifications of all the objectives considered relevant to different subject fields. The test constructor has for him in it, a readily available wealth of test situations for guiding and improving his work. To the students of curriculum and evaluation, the reinforcement of the theoretical with the practical aspects attempted in the handbook is not only likely to help them in acquiring an insight into the concept and underly-

ing processes of teaching and testing, but also in developing in them a conviction about the educational evaluation of the same. For each of the above categories of persons, the handbook contains sufficient material to pick and choose. It has also an additional potential of rendering the processes of decision taking in the specific situations of their tasks not only faster, but also easier.

It would not be out of place to narrate an episode about the handbook under review. Not very long back it was being discussed among some educationists. One of them first of all praised the book and then to the surprise of all made a contradictory statement by saying ''still this is not a good book''. On being asked to further elaborate this point, he said, ''it is too heavy a load on the chest if one wants to read it while lying down''. (The book weighs about two kilograms). Quick came the retort from another participant in the discussion ''yes, that's right, its contents cannot be taken (in) lying down''.

Apart from this interesting episode, it would probably be correct to say that even if the authors had more time, it was difficult to condense the contents further without putting a handicap on the intelligibility and appreciation of its contents by the clientele it has meant for.

The handbook is instrumental in introducing three major concepts in the field of education—those of formative and summative evaluation and that of mastery learning. Though comparatively of recent origin these concepts have started being understood and appreciated in different countries of the world. When internalised these concepts are likely to impart the educationists with greater confidence in approaching their tasks than what they have had so far. The concepts have applications not just within the framework of educational evaluation, but have a wider significance in curriculum development. As a matter of fact formative and summative evaluation of curriculum is one of the latest targets of the curriculum makers in current times.

Some Gaps

Despite its weight and volume, the handbook does have some gaps which require to be filled in. The inclusion of only a chapter

on the evaluation of affective objectives falls short of satisfying the expectations of the readers which the title of the handbook raises. Furthermore, the complete absence of the psycho-motor domain from the contents of the handbook leaves yet another unquenched thirst of the readers. It is certain that the authors are aware of these gaps and it is hoped that they are promoting research and other allied activities for filling in the same in not a very distant future. When these two gaps are filled, the handbook would really be able to claim to be comprehensive. It would have been better if this aspect had been touched upon in the preface itself as this would have served to hedge in the expectations of the readers about some not available contents in the handbook.

Conclusion

As has been stated in the handbook itself the principles enunciated by it, the practices indicated and the solutions suggested have found varying degrees of application in different parts of the world. As a subsequent step to the development of this handbook, it may therefore, be worthwhile to study the prevalent systems of educational evaluation in different countries. Such a study will help identify similarities and differences between various systems and in estimating the extent of their correspondence with the models suggested in the handbook. It would also help the various nations to know about the stage of development of their respective systems of evaluation and they could take advantage of the experiences of other countries in this area. Secondly, such a study will also help collect empirical evidences about the measure and form of the applicability potential of the various new ideas in the field of educational evaluation in different social and economic orders, political systems, administrative set-ups and cultures.

The handbook could be highly commended not only as the first attempt at bringing together such authentic and wide variety of material on the subject under a single cover, but also because the improvement of student learning is its main concern. It should be treated as a must for the libraries of all educational institutions and agencies.

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(Contd. on Cover iii)

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CONTENTS

Vocabulary of Pre-School Children

Anna Mathew
V. Sireesha

The present study is an attempt to make a comparison of the vocabulary of pre-school children of age range $3\frac{1}{2}$ years to $4\frac{1}{2}$ years and whose mothers had different levels of educational achievement. The sample for the study was selected from among children who were attending different nursery schools in Tirupati, where Telugu is the spoken language. Ten models were used to stimulate children to talk. The results indicated that there is a positive correlation between children's vocabulary and their mother's educational status.

The influence of factors like educational level of the parents, their economic status, and occupational variations etc., on the development of language skills of children have been studied by many investigators. Brandenburg (1919) found that a child who was reared in a home where the parents were well-educated, developed larger language skills. Chamberlain (1900), McCarthy (1930), Day (1932) and Davis (1937) mainly concentrated on socioeconomic variations. They found that the upper occupational groups tended to give greater consideration to the intellectual needs of children and to provide facilities to improve their intellectual capacities which ultimately resulted in making these children excel in language skills as well.

If, during pre-school days, opportunities are made available to the child to learn by feed-back such as by being heard, corrected and modified, he gains control over his words while using the same in his social

environment. Williams (1937) found that accuracy of articulation, use of correct words, length, completeness, and complexity of sentences correlate with one another. Young (1940) made an effort to see the influence of home environment on the development of language of children. Children of professional group of parents were found to be superior to those of the non-professional group. In brief, all these studies show that the families which enjoy a high status socially, economically, and occupationally provide better environment to their children, which results in their larger language development. As the child grows older, interactions with siblings and other children as well as with impersonal sources exercise their influence on him. Consequently, language skills improve with the age of the child (Nice and Smith 1935). Bandura A and Huston A (1961) found that much incidental learning takes place through identification with the adults and other members available in the environment. They found that even the affectionate demonstration of mothers help their children acquire reading readiness at an earlier age.

Method

The present study was undertaken to make a comparison of the vocabulary of children of mothers with different levels of academic education. The ages of the children ranged between 3½ and 4½ years. During pre-school years the influence of home on language development of children is likely to be the maximum, while at a later age, the influence of the school and peers is likely to be greater. So it was decided to take the children between this age-range. The study was undertaken in Tirupati, where the spoken language is Telugu. Though Tirupati is a small town, it is a University area where a large number of people with high academic qualifications are employed. A great majority of the middle income groups are anxious to have their pre-schoolers attend nursery schools. As a result, a large number of nursery schools have come up lately and parents who can afford to pay ten or twelve rupees per month per child, do send their children to these schools.

The sample for the present study was selected from five of the local nursery schools and the relevant background information about each child were gathered from the school records and through home visits. Since the effect of mothers' education on children's vocabulary was the topic of the study, it was decided to have the fathers' educational status as well as the economic status of the family, controlled. For this reason, only children belonging to families with a monthly income of Rs. 400-800

and whose fathers have had education upto the collegiate level, were selected for the study. The educational status of the mothers naturally differed considerably.

The total number of subjects selected for the study was fifty-four (Table 1). The educational status of their mothers ranged from illiteracy to the collegiate level. The proportion of illiterate mothers was very small (7·4%) while 50% of them had varied degrees of collegiate education with a large majority having discontinued at or after the Pre-University class (P.U.C.).

TABLE 1

Sample Distribution

Mothers' educational status	*Group*	*No. of children*	*Percentage*
Illiterate	0	4	7·4
Primary school	I	8	14·8
Elementary school	II	9	16·7
Secondary school	III	6	11·1
Collegiate level	IV	27	50·0

Basing on McCarthy's study, it was decided to use models to stimulate children to speak. Decision regarding the number of responses to be recorded and the models to be used to stimulate children to speak, was made basing on the results of the preliminary test. The models included were those which were familiar to the children belonging to a middle class family in Tirupati. These were tooth brush, tumbler, banana, crow, telephone, jeep, tiger, elephant, train, (laundry) iron and ironing board. The study was conducted in a structured experimental situation, so as to ensure uniformity in the setting for all children.

The experiment was conducted in a well-ventilated room free from disturbances. The investigator arranged the models on a carpet and kept them covered. The models of cow, hen and mango were used to get the children oriented towards the experimental situation. When the investigator became convinced that the child fully understood what was expected of him or her, she quietly exposed the selected tools one by one to the child—so that gradually all the models were exposed without causing any distraction during the process. Twenty-five statements were recorded from each child exactly as they sounded to the investigator.

A statement was considered to be a single response, whether it be a complete or incomplete sentence. The time taken by each child for twenty-five responses was also noted. The room was arranged afresh before another child was called in.

The sample was class'fied into five groups depending upon the educational status of the mothers. Thus '0' group included those whose mothers were illiterate, while groups 1, 2, 3 and 4 represented children whose mothers educational status were primary, elementary, secondary and collegiate levels respectively.

TABLE 2

Performance of Children on Different aspects of Language

Mothers educational status	*No. of words per 25 statements*	*Total time per 25 statements*	*No. of words per minute*	*M.L.R.*	*Average No. of complete sentences per child*
0	55·0	9·7 min.	5·67	2·17	18·75
I	48·2	12·37 min.	3·9	1·93	13·37
II	61·4	14·5 min	4·23	2·47	15·9
III	62·0	17·0 min.	3·64	2·49	17·16
IV	73·4	14·4 min.	5·09	2·95	22·22

* $r=0·96$ * $r=0·96$ * $r=0·73$

r=Correlation coefficient

TABLE 3

Mothers educational status	*Proportion of English Words*
0	6·36%
I	7·25%
II	6·67%
III	7·65%
IV	14·25%

Excluding the children of illiterate mothers, a progressive increase in the number of words used was observed with the increase of mothers educational status. The average number of words in the total statements

were found to be closely correlated to the mother's educational status except in the case of the children of illiterate mothers ($r=0.84$). When the children of illiterate mothers were excluded, the r value increased to 0·96 ($t<.01$). The number of complete sentences indicated a gradual rise corresponding to the increase in the educational level of the mothers. The '0' group again was an exception. Here again r value increased from 0·41 to 0·73, when '0' group was excluded. The MLR (Mean length of response) was observed to be closely correlated to the mother's educational status except in the case of children of the illiterate mothers ($r=0.84$). When the children of the illiterate mothers were excluded, r value increased to 0·96, which statistically was highly significant ($t<.01$). Children whose mothers had collegiate education used a greater number of English words, when compared to the other groups. However, occasionally it was observed that some of the others also made fluent use of certain English words which are more or less incorporated into the Telugu language.

Discussion

In India children are desired because they are loved, and the mother is expected to have utmost devotion to her children (Ross '61). A mother with lesser academic education is more likely to hold this traditional view and to be prepared to spend all her time for their benefit and to lavish her affection on them. This probably explains why the children belonging to group '0' consistently performed better than those of group 'I'. The lesser restrictions imposed by them encourages these children to gain a sense of belongingness, self-confidence and self-importance. Since the mother gets immense pleasure in listening to his prattles, she is more permissive with her children and this attitude on the part of the mother facilitates talking which in turn helps in the widening of the child's vocabulary (Bandura & Huston). Rheigold (1925), Bayley (1925) and others found that this 'give and take' of attention provides opportunity for intimate language interaction with the child. On the other hand, the mothers of group 'I' are likely to be more conscious about the 'right' things to do. As a result they place emphasis on 'acceptability' through conformity. This naturally imposes greater restriction on the child. Moreover, since their knowledge is limited they tend to be insufficient. The sum-total of all this on the child is to inhibit his verbal expressions. Parents who have some education, generally try to satisfy children's curiosity over a wide range of topics. Mothers who had education

above the middle school, seemed to maintain a close contact with their children and to provide them with opportunity for expansion and for the correct use of language. Although both the mothers of groups III and VI provide similar opportunities, since there is a difference in the depth of their knowledge, Group IV scores higher than Group III. The result further supports Palermo's (1947) conclusion that the higher educational level of parents is conducive to the rapid development of language in children, due to the greater democratic treatment meted out.

A child learns language through imitation. The child begins to imitate single words and then spells combination of words, a majority of which are noun verb combination consisting mostly of nouns. Once he starts using words, he finds wider language, which is pre-established through conceptualization. As a result, he starts using other parts of speech, though nouns generally predominate in their vocabulary. It comes to light from the present study that 40 to 45% of the total vocabulary of the entire group consisted of nouns. In the case of group 'I' this was found to be 52%, which was the highest of all the groups. Group 'I' tended to confine themselves to naming of objects with an occasional attempt at explaining the obvious. Group 'IV' on the other hand tended to verbalize a great deal about their experiences with the objects. As a result, their MLR as well as the time taken to speak out 25 statements are greater and the percentage of nouns are lesser compared to the rest of the groups. The proportion of nouns was found to decrease with the increase of vocabulary.

As children grow older, they substitute pronouns for nouns. As children at this age are egocentric, their vocabulary tends to be centred around themselves. Goodenough (1938) found that the use of first person singular decreased in controlled situations and simultaneously increased the usage of third person singular and demonstrative pronouns. The presence of an adult in a controlled situation probably induce the children to pass on information to the adult. This tended to limit the egocentric talk. In the case of the children of '0' group, their experiences and interactions are likely to be limited to their family members. So, even when they are exposed to other adult members, they tend to make greater use of first person singular pronoun. The following examples illustrates the differences between group '0' and 'IV'.

Child of '0' group:

I go to Temple.

I take 'prasadam' and return home.

Child of 'IV' group:

(A big train came to Tirupati).

My father, mother, sister came (in the train).

In my house there is a long railway track.

Plural of first person (we), second person (you), third person (they) are used only by children whose mothers are educated beyond the elementary school level. The 'we' feeling appears to emerge rather slowly in the group under study. The pronouns 'we' and 'they' were the least used by the children while the demonstrative pronouns 'this' 'that' were the most.

Use of adjectives and prepositions increased gradually with the education of the mother. The use of pronouns, adverbs, adjectives, prepositions and conjunctions is indicative of the mental grip of the child as suggested by Drever. The recorded vocabulary certainly shows that comprehension is greater, when the educational status of the mother is greater. The mothers who have higher educational status probably tend to communicate verbally to a greater extent with their children which in turn helps to improve their language skill.

Telugu numerals are used by all the children but English numerals are used only by group IV. The mothers who have higher educational status probably tend to make greater use of English words and numbers and their children naturally tend to 'pick' them up. Some English words are so frequently used even by the less educated, that they have become more or less incorporated into the local language with slight vernacular deflections. But those who are more conversant with the English language take particular care to see that they (the English words) preserve their original form.

The present study further reveals that the mispronounciations are the greatest in groups '0' and 'I'. Many studies have proved that the accuracy of articulation depends on the size of vocabulary (Williams 1937) the occupational level of parents (McCarthy) and their social status (Caff B. N.) and of course all these are in inverse proportion to the educational status. In Western countries where self-choice is the accepted mode of mate selection, disparity between the educational level of the husband and wife is likely to be insignificant. In India, where marriages are mostly 'arranged' by elders, while great care is taken to keep the differences in their social status and religious background to the minimum, the chances of disparity in personal matters like interest, education etc., are likely to be great. As a result, the correlation between

children's vocabulary, and the social and occupational level of parents which William (1937) and McCarthy (1930) found to be high in their studies, may not hold good with an Indian sample. However, when the education of the mother and father were equally high, the correlation was significantly high as per the findings of the present study.

The results of the study further indicated that while group IV were able to respond to all the models, group '0' failed to give any response to some models. This probably is because of the negligence shown towards concept formation in children by the mothers with lesser educational achievement. Thus it was found that the education of the mother influences her attitude towards child's development and achievement. However, even if the mother is not educated, the fathers can compensate for it by giving information and guidance. If that be the case, such children will not be found to be adversely affected by the low educational status of the mothers.

Conclusion

Mothers education has a great influence on the development of vocabulary of the children—the greater the education of the mother, the wider the vocabulary of the child. In all aspects of vocabulary, such as number of complete sentences, number of words and MLR, '0' group excelled group 'I', probably because of the greater permissive attitude shown and the passive encouragement given by the mothers of the former group in comparison to that of the latter. Mispronounciation and use of English words decreased with increase of mother's education. Further, while group IV responded to all the models, some children of the other groups failed completely to respond verbally to a few models. Thus all aspects of language development seem to be positively correlated to the education of the mothers.

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Job Satisfactions of Teacher Educators

Evelyn Marr
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The extent of satisfaction of Teacher Educators with different aspects of their jobs have been studied. An attempt has been made to determine the satisfactions that tend to go together.

Teacher Educators have a key role in the improvement of education. Therefore, it is important that their best efforts be devoted to it. Since there is so much flexibility in the work they are required to do, and the manner in which they can do it, the contribution they make to the field will depend in part on their involvement in their work and the satisfactions they derive from it. Hence it was decided to study the satisfactions of teacher educators with respect to different work values.

PROCEDURE

The Instrument

For the purpose of the study a proforma was drawn up. Items of Super's Work Values Inventory (Super 1962) which were applicable to the job of teacher educators were included in it. A second source of items was the responses to a preliminary proforma which was sent to

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the teacher educators earlier. This proforma contained the following open-end items.

There are certain advantages and disadvantages in nearly every job.

1. Please state here what you like best about your present job.
2. Please state here what you like least about it.

Items from both sources were classified according to the work values listed by Super. However the following changes were made.

'Supervisory relations' was broken up into two categories, one relating to immediate supervisor, and the other to the policies of the management. This was considered necessary because it is possible that the two may differ sharply. Besides it seems reasonable to assume that the immediate supervisor has more influence on the day-to-day work of the individual, while management policies determine the rewards for work.

The 'management' scale of the work values inventory is here designated as 'responsibility'.

Aesthetics has not been included because items such as 'Make Something Beautiful' did not appear to be relevant.

The items included in each scale are indicated in Appendix I.

The teacher educators were asked to rate each item on how much of it they had in their job, how satisfied they were with respect to it, and how important it was to them. In this paper only ratings on extent of satisfaction are presented and discussed. The following scores were assigned to the ratings.

Very satisfied	5
Fairly satisfied	4
Neither satisfied nor dissatisfied	3
Fairly dissatisfied	2
Very dissatisfied	1

Assessing the reliability of the data obtained through the proforma posed a special problem. It was difficult to find a group of teacher educators who were willing to complete the proforma twice. Finally this was arranged at a very late stage, with forty-six persons, not included in the main sample of the study. The aim was to have a gap of two weeks between the two administrations, but the majority of respondents had to be contacted by mail, and reminders sent to them. Hence the period between the two administrations varied from two weeks to about two months. The test retest reliabilities for satisfaction on the scales are given in Table 1.

TABLE 1

Reliabilities of the Scales

Scale	r
Advancement	·766
Creativity	·742
Intellectual stimulation	·729
Management	·728
Association	·695
Altrusion	·695
Security	·670
Earnings	·639
Achievement	·569
Interesting work	·558
Way of life	556
Surroundings and facilities	·548
Independence	·431
Responsibility	·430
Variety	·342
Prestige	·327

Several of the reliability co-efficients are very low. This is particularly true of independence, responsibility, variety and prestige. As stated earlier, by the time these co-efficients were available it was too late to modify the instrument. They are presented here only to give an indication of the uncertainty in responses.

Subjects

The proforma was sent to all the secondary teacher educators in the states of Kerala, Uttar Pradesh, West Bengal, Maharashtra and Punjab. Altogether 1,187 proformas were sent, out of which only a little over 400 were received back. Since it was decided to make a factor analysis of the extent of satisfactions relating to different work values, incomplete proformas could not be included in the analysis. Several teacher educators did not respond to an item on transfers as it was not applicable to them. Therefore this item was omitted. If, besides this item a respondent had failed to complete more than two items, his responses were not included in the analysis. In cases where only one or two items were left incomplete the middle score *i.e.* 3 was assigned. As a result of the exclusion of incomplete proformas the sample size was further reduced. Altogether 366 cases were included,

of these 290 were men and 76 women. The statewise position of respondents is given in Table 2.

TABLE 2

Respondents

	Kerala	*U.P.*	*W Bengal*	*Maha-rashtra*	*Punjab*	*Total*
No. of questionnaires sent	145	392	196	280	176	1189
No. of respondents included in analysis	68	102	63	110	23	366

Since the response is rather poor the results can be considered applicable only to the respondents, and not the other teacher educators in these states.

FINDINGS

Satisfaction with Respect to the Subscales

The mean and standard deviation of the ratings on the Scales are given in Table 3.

TABLE 3

Average Ratings on the Scales

Scale	*Mean*	*S.D.*
Interesting Work	3·95	·95
Prestige	3·79	·83
Association	3·78	·83
Way of Life	3·71	*
Immediate Supervisor	3·64	1·04
Intellectual stimulation	3·55	·77
Responsibility for management	3·50	·81
Management policies	3·46	1·14
Variety in work	3·39	1·06
Independence	3·31	1·87
Achievement	3·23	·77
Altrusion	3·24	·83
Security	3·17	·96
Facilities	3·06	·97
Creativity	3·00	1·08
Advancement	2·84	1·04
Earnings	2·64	1·21

*Due to some error the S.D. for the scale "Way of Life" was not calculated and the loadings of this scale in the factor analysis were excluded.

N The largest number of teacher educators are satisfied with the fact that they find their work interesting. The average rating for this scale is not significantly different from 4 which represents " fairly satisfied ". The average ratings for satisfaction with respect to Prestige, Association, Way of Life, Immediate Supervisor, Intellectual Stimulation, Responsibility, Management Policies, Variety in Work, Independence, Achievement, Altrusion and Security lie between 4 (fairly satisfied) and the mid-point of the scale 3 (neither satisfied nor dissatisfied). The average rating with respect to satisfaction with facilities is not significantly different from 3 and for satisfaction with respect to creativity is at 3. The average satisfaction with respect to Advancement and Earnings lie between 3, the mid-point, and 2 which stands for fairly dissatisfied.

Factorial Dimensions of the Satisfactions

The inter-correlations between satisfactions with respect to the work values scales are given in Appendix II. Factor Analysis by the method of principal components was done on a IBM-1620 computer. The factorial loadings were subjected to orthogonal rotation by the varimax criteria due to Kaiser (1958). The significant factor loadings are given in Table 4.

TABLE 4

Factorial Loadings of Satisfaction Scales

Scales	*Factor I*	*Factor II*	*Factor III*
1. Intellectual Stimulation	·681		
2. Achievement	·680		
3. Altruism	·636		
4. Creativity	·597		
5. Immediate Supervisor	·590		
6. Responsibility	·583		
7. Independence	·549		
8. Associates	·548		
9. Advancement	·466	·610	
10. Security		·668	
11. Management Policies		·571	
12. Surrounding facilities		·486	
13. Earnings		·484	
14. Prestige			·597
15. Variety			·558

The first factor may be identified as satisfaction from work which is stimulating, which gives the feeling of accomplishing something and doing good (Intellectual stimulation, Achievement, Altruism, Creativtiy), and the conditions that make it so, (Immediate supervisor, responsibility, independence and associates). It relates to the intrinsic satisfaction from work itself and the opportunity for self-expression. It may also be defined as the work content factor (Friedlander 1966). Persons high on it have opportunity to use their minds, to continue to learn, have stimulating contacts, feel that they are accomplishing something and doing good. They have responsibility and independence and satisfactory relations with their immediate supervisor and associates. The moderate loading of advancement on this factor is probably due to its relation with immediate supervisor.

The second factor may be called the work context factor—it relates to the rewards of work, or what the job provides for the worker (Security, Advancement, surroundings and facilities, earnings). Management policies have a high loading on this factor, which is to be expected because the management determines the rewards and conditions of work. It is interesting to note that, security and advancement have a higher loading on this factor than earnings, indicating that a concern for the future is more important part of it than present earnings.

The third factor which has high loadings on the variables prestige and variety is difficult to explain. It is possible that those teacher educators who are involved in the various activities of the college, have more variety in their work and also perceive they have more courtesy and respect from students. Similarly those who participate in the extension programmes find they have more variety in their work and more prestige in the community. However it may also be noted that these two scales, prestige and variety have low reliabilities. Therefore this factor needs further investigation.

The splitting of supervisory relations into two scales, one relating to immediate supervisor and the other to management policy, proved interesting. It is seen that these items fall under different factors. As expected, satisfaction in regard to relationship with immediate supervisor is related to satisfactions derived from work itself and conditions conducive to it. On the other hand management policies has a loading on the second factor that is the rewards of work.

Discussion

The findings lend support to Herzberg's (1963) two factoı theory of job satisfaction, (Herzberg, Mausner & Snyderman, 1959) in that the two main factors abstracted are similar to Herzberg's "satisfiers" and "dissatisfiers". However, no attempt was made to test whether either of these factors acts as a satisfier or dissatisfier. The job content factor corresponds to Herzberg's "satisfiers" or "motivators" which include achievement, recognition, interesting work, responsibility and advancement. The job context factor is similar to Herzberg's "dissatisfiers" or "hygienes" which are company policy and administration, supervision, salary, and working conditions. The marked difference is that in Herzberg's study relations with supervisor is a dissatisfier while in the present study it is a job content factor. In the studies carried out in this country (Rao 1971; Lahiri & Srivastava, 1967) Supervisory relations and relations with co-employees are included in hygienes while in the present study they fall in the job content factor.

The approach in these studies was completely different from that of the present study. In them the investigators tried to find out which aspects of the job contributed to satisfaction and which to dissatisfaction. In the present study it was attempted to determine which aspects tended to go together. The marked overall similarity of the factors is therefore all the more remarkable.

Implications of the Study

Administrators are usually aware of the need to pay attention to job context factors, while the study reveals that both job content and context factors are important. In fact Friedlander's (1966) study showed that job content factors are important for high status White Collar Workers, and Rosen (Rosen 1963 as reported by Bockman, 1971) found that whi'e collar workers associate varied, complex, demanding jobs with satisfaction. Hence one might expect such factors to be important for a highly educated group such as teacher educators. It is necessary to create the conditions which will enable teacher educators to use their minds, have the opportunity to accomplish something, and to do work they consider useful and creative, as well as to have satisfying human relationships in their work.

APPENDIX I

The Scales *

1. *Interesting Work*

   Work that is interesting for you.

2. *Variety*

   Variety in your work.

3. *Creativity*

   Opportunity to try out new ideas.
   Opportunity to experiment or carry out research.

4. *Prestige*

   Prestige of your job in your community.
   Courtesy and respect from students.

5. *Responsibility*

   A part in managing the affairs of your institution.
   Responsibility for getting things done.

6. *Independence*

   Freedom to do things your own way.
   Freedom to come and go as you please.

7. *Advancement*

   Chances of promotion.
   Recognition of merit.

8. *Earnings*

   Salary in relation to your qualifications and experience.
   Salary in relation to your needs.

9. *Security*

   Job security.
   Confidence that seniority will protect your position.
   Retirement benefits offered.

10. *Association*

    Colleagues whose company you enjoy.
    Colleagues whom you can trust.
    Team spirit among colleagues.

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* *In the actual tool the items were presented in random order and not separated for the different scales.*

11. *Altruism*

Opportunity to help others.
Opportunity to really improve education.
Opportunity to perform a genuine public service
Opportunity to live upto your social ideals.

12 *Facilities*

Provision of teaching aids.
Types of class rooms.
Place to work during your free periods.
Lounge and toilet facilities.

13. *Achievement*

Feeling of accomplishing something worthwhile.
Freedom from useless work and interruptions.
Opportunity to see if your work has borne fruit
The syllabus you have to follow.
The system of evaluation of your students.

14 *Management Policies*

Management that is fair.
Management that is reasonable.

15. *Immediate Superior*

Immediate boss who is just and fair.
Immediate boss considerate.
Boss who values your opinion.
Boss who keeps you informed of major plans.

16. *Way of Life*

The locality in which you live.
Your living accommodation Adequate.
Your living accommodation. Pleasant and attractive.
The vacations you have.
Your working hours.
The system of transfers.

17. *Intellectual Stimulation*

Opportunity to use your ability, education and training.
Opportunity to add to your knowledge.
Library facilities
Opportunity for exchange of ideas with students.
Interest and response of students.
Opportunity for exchange of ideas with others in your field.
Encouragement to submit ideas for improvement.

APPENDIX II

The Intercorrelations Between the Scales

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Interesting Work		·37	·43	·39	·47	·39	44	·34	35	·31	·47	·33	·51	·34	·35	·15	·54
2. Variety			·38	·45	·41	·41	30	·33	23	·28	·39	·33	·45	17	·23	15	·46
3. Creativity				·31	·49	·51	59	·41	·45	·34	·68	·46	·62	·45	·43	·20	·69
4. Prestige					·35	·39	39	46	·42	·16	·35	·35	·41	·24	·21	·24	·41
5. Responsibility						·61	·49	·34	·48	·43	·51	·39	57	·41	·49	·26	·58
6. Independence							·57	·37	·49	·36	·54	·38	·57	·45	·53	·21	·53
7. Advancement								·53	·63	39	58	·53	·60	·54	·54	·28	·61
8. Earnings									·48	28	·45	·46	·48	·36	·32	·31	·46
9. Security										·29	·47	·47	·46	·54	·47	·31	·50
10. Association											·39	·34	·52	·27	·46	·16	·49
11. Altruism												51	·72	·43	·47	·31	·76
12. Facilities													58	·43	·41	·40	·60
13. Achievement														·46	·53	·30	·74
14. Management Policies															53	·27	·48
15. Immediate Supervisor																25	·55
16. Way of life																	·36
17. Intellectual Stimulation																	

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Anxiety—Persistence and Performance on 'Programme'

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The present investigation into the relation between some personality variables (viz., *anxiety, and persistence*) *and the performance on a programme is an attempt to probe into the possibilities of utilising Programmed Learning Material (P.L.M.) in a classroom comprising students of varied personality dimensions.*

Studies conducted so far suggest there exists some relationship between anxiety and persistence and academic achievement. Sarason (1957), Spielberger and Katzenmayer (1959), Cook (1959), Spielberger (1962), Burton (1966) and others found that there exists a significant negative correlation between anxiety and academic achievement. Sarason (1957) found significant negative correlation between 'test anxiety' and measures of scholastic aptitude but a significant positive correlation between 'General anxiety' and college grade point averages (GPA). Spielberger and Katzenmayer (1959) using Tayler's M.A. scale reported a significant negative correlation between these two variables. Cook (1959) found that honours students with lower scholastic ability had significantly more anxiety than those with high ability. Spielberger (1962) found that there was a negative relationship between anxiety and achievement in students of medium intelligence while in highly intelligent subjects, anxiety facilitated performance. Burton (1966) too found that the high achieving students were not very anxious and not emotionally disturbed. Such results have also been observed in India by the recent studies conducted by Saxena (1965) and Sinha (1966).

Sarason and Mandler (1952), Malarzzo, Viett, Guze and Saslow (1954) and David and Erikson (1955) could not find any significant relationship between the manifest anxiety and college grade point averages.

Savage (1962) presented evidence for a U-shaped relationship between anxiety and performance. Fein (1963) also found a curvilinear relationship between these two variables. Sharma (1970) in his study also found a curvilinear relationship between these two variables—thus supporting the inverted U-hypothesis. Singha (1971) in his latest study found no relationship between anxiety and academic achievement.

In the area of programmed learning, a study reported by Fishman (1962) showed no significant influence of personality factors on the variability in the prediction of academic performance.

Another study on personality characteristics related to student performance in pairs on programmed instruction was carried out by Dick and Seguin (1962). In this study one group of students were paired on the basis of similarity in dominance—submissiveness scores, other group on the basis of dissimilarity. No significant differences were found in the programmed learning results.

In the study of Lambert, Miller and Wiley (1962) intelligence was found to be significantly associated with the amount of information required from the programme.

The study of Feldhusen and Eigen (1963) showed that the variance in learning which might be attributed to IQ seemed less essential than that which might be attributed to general achievement level. In no study IQ per/se was found to be the fundamental learner variable in programmed instruction.

The study conducted by Leith (1968) brings in another dimension. Here the instructional method showed a significant positive relationship with extraversion and a significant negative relationship with neuroticism (general anxiety). In other words the greater the degree of anxiety the lower the test score.

A further study by Shadbolt and Leith (1967) showed that the extroverts were more successful than introverts with the discovery type of programme. Introverts were good with the clearly structured well-guided one, though extroverts were significantly poorer with this type of learning. Overall, non-anxious (below the median) subjects were better than anxious ones.

A study was reported by Leith and Wisdom (1969) on the effects of error making and personality on learning. The anxious subjects were found to be poorer than stable ones. This indicates that, in this situation anxiety must interfere with learning and performance. Trown and Leith (1970) however showed that individuals with greater anxiety (scores above the median) achieved higher, though no significant differences were found.

A number of studies related to persistence and academic achievement have also been conducted by a number of investigators. Fernald (1912), Ryans (1939), Crutcher (1939), Thornton (1940), MacArthur (1951), Burt (1954) and others found a significant positive relationship with persistence and academic achievement. This result has also been verified in India by Bhattacharya (1963).

The possibility thus arises that when the stress of difficulty is avoided, as in small step programmes, personality differences do not emerge, but when the mental effort is greater, as in the studies cited earlier, personality factors have some influence on achievement.

A survey of the earlier researches in the field of personality dimensions as related to the efficacy of programmed learning makes the investigator feel that there is hardly any attempt to study the role of persistence, though a handful of studies included anxiety as one of the variables. This was the prime motivation for the investigator to take persistence as one of the personality variables in the present study.

The purpose of the present study was to find out the relationship between anxiety, persistence and performance on a programme.

Objectives of the Present Investigation

The objectives of the present investigation were:

(i) To explore the effects of anxiety, and persistence on the performance on a programme.

(ii) To explore the possibilities of using programmed learning technique in Indian classrooms.

Definition of Terms

For the purpose of the present inquiry the following definitions were accepted.

(i) *Anxiety*: In this investigation anxiety means a chronic complex emotional state with apprehension or dread as its

most prominent component, characteristic of various nervous and mental disorder.

(ii) *Persistence*: By persistence the investigator means that particular personality factor which helps one to continue a particular activity in spite of the obstacles and objections coming in one's way.

(iii) *Performance*: In this investigation the term 'performance' means the pupils' achievement on the criterion test administered after the pupils completed the programme.

(iv) *Programme*: The word 'Programme' in this investigation refers to a programmed learning material prepared on the basis of the principles of programmed learning. The programme used for this investigation implies the Skinnerian way of programming which requires a student to construct a response overtly.

Delimitations

(1) For the present inquiry it was decided to restrict the experiment to English medium schools of the city of Baroda.

(2) The programme selected was a linear one and was prepared by Shah (1969) "A Programme on Addition and Subtraction of Directed Numbers".

(3) The present investigation covers only two personality variables *viz.*, (i) Anxiety, and (ii) Persistence. Although many personality variables could be thought of for such a study, the investigator decided to concentrate on only these two.

(4) The sample is confined to students of Standard VIII.

Hypotheses

In this investigation certain assumptions were considered as basic in order to decide the later theoretical framework like tools, techniques and research design. The assumptions were as follows. There is no significant differences on the performance of a programme between the students having:

(i) high anxiety-high persistence and high anxiety-low persistence.
(ii) high anxiety-high persistence and low anxiety-high persistence.
(iii) high anxiety-high persistence and low anxiety-low persistence.
(iv) high anxiety-low persistence and low anxiety-high persistence.

(v) high anxiety-low persistence and low anxiety-low persistence.
(vi) low anxiety-high persistence and low anxiety-low persistence.

TOOLS

For the purpose of the present investigation the following tools were used:

(a) IPAT Anxiety Scale

This scale was designed and constructed by Cattell and Scheier (1957). This test had been widely used by a number of investigators in order to measure the anxiety. It is applicable to all, particularly to the age group of 14 or 15 years and above. The reliability co-efficients obtained by different investigators by test retest or split half or K.R. method were found to vary between 0·80 and 0·93.

The construct or concept validity of the test was estimated by different investigators and the co-efficients were found to vary from 0·85 to 0·90 for the total scale.

The external or concrete validity co-efficients for the test were found to vary from 0·30 to 0 40 in different experiments.

(b) Persistence Test

This test was constructed by Bhattacharya (1963). Persistence of the high school students can be measured using this test.

The reliability co-efficient of the test was found to be 0·75 when measured by test retest method. The same when measured by split half method and corrected by Spearman-Brown formula to full test length was found to be 0·71. The validity co-efficient of the test was also found out by calculating the correlation between the scores on the test battery and the 'teachers agreed ratings'. The co-efficient of correlation was found to be 0·69.

(c) Programme

For the present investigation a programme in Algebra, *viz.*, "Addition and Subtraction of Directed Numbers" prepared by Shah (1969) was selected. The programme is linear having 95 frames.

SAMPLE

Eighty students comprising both the sexes were selected at random from the English medium schools of the city of Baroda. Amongst those

eighty students, twenty students had high anxiety–high persistence, twenty students had high anxiety–low persistence, twenty students had low anxiety–high persistence and twenty students had low anxiety-low persistence.

PROCEDURE

First the anxiety test and the persistence test were administered to the students. According to the scores obtained by the students on the respective tests twenty students having high anxiety–high persistence, twenty students having high anxiety–low persistence, twenty students having low anxiety–high persistence and twenty students having low anxiety–low persistence were selected. Then the programme was given. As soon as the students completed the programme, the criterion test was administered and the performance of the students on the criterion test was noted.

RESULTS

The effects of anxiety and persistence on the performance of the students on the programme was tested using the analysis of variance technique. The following tables will be self-explanatory of the experimental data and results observed.

TABLE 1

Experimental Groups

		PERSISTENCE	
		High	Low
ANXIETY	High	A	B
	Low	C	D

TABLE 2

Scores obtained by the Four Groups on the Criterion Test of the 'Programme'

Group A	Group B	Group C	Group D
High Anxiety and High Persistence	*High Anxiety and Low Persistence*	*Low Anxiety and High Persistence*	*Low Anxiety and Low Persistence*
15	11	11	15
15	10	13	11
12	17	10	13
11	12	14	12
11	13	11	10
12	12	11	11
10	11	12	13
11	10	11	9
10	15	15	8
11	10	12	13
10	10	13	10
11	9	10	11
10	13	9	15
6	12	13	13
11	11	10	12
17	10	11	11
11	10	16	11
13	11	13	9
8	9	11	13
10	10	13	12

TABLE 3

Mean Scores obtained by the Four Groups on the Criterion Test

Group	*A*	*B*	*C*	*D*
Mean score	11·65	11·30	11·95	11·60

TABLE 4

Analysis of Variance of the Criterion Test Scores for the Four Groups

Source of Variation	*df.*	*S.S.*	*M.S.*	*F*	*Significance*
Among Means	3	4·25	1·42		
Within Groups	76	356·50	4·69	·30	Not Significant at ·05 level.

Here F ratio is not significant (the tabulated value of $F_{.05}$ is 2·72). This indicates that there is no significant difference between the students of any two groups on the performance of the programme.

Since F is not significant even beyond ·05 level, one can infer that the difference between the performance of any two groups on the programme is not significant. So anxiety and persistence have no significant effect so far as the performance of the students on the criterion test of the programme is concerned.

Therefore, all the hypotheses are retained.

Observations

(i) It can be seen that the overall differences between the score obtained by the students on the criterion test of the programmes are not significant even at ·05 level.

(ii) The four groups could be arranged according to merit (on the basis of mean criterion scores, Table 3) in the following order: C, A, D, B.

Position	*Group*	*Personality trait*
First	C	Low Anxiety-High Persistence
Second	A	High Anxiety-High Persistence
Third	D	Low Anxiety-Low Persistence
Fourth	B	High Anxiety-Low Persistence.

As the analysis of variance result is not significant (Table 4) it can be said that the four groups are equally effective as far as the performance on the 'programme' is concerned.

(iii) There exists no significant relationship between the personality variables (anxiety, persistence) and the performance of the students on the 'programme'.

Discussion and Conclusion

The findings of the present investigation are somewhat similar to some of the studies which have been already been carried out by different investigators abroad. Leith and Trown (1970) found that individuals with greater anxiety (score above the median) achieved higher than the individuals with low anxiety, though no significant differences were revealed. But Leith (1970) got a different result. He found that the greater the degree of anxiety, the lower the test score. The result of the present investigation shows that *no significant differences exist on the performance*

of a ' Programme ' between the students of any two groups, viz., *A and B, A and C, A and D, B and C, B and D, and C and D.*

This finding of the present investigation supports the result of Shadbolt and Leith (1967), Leith and Bossett (1967), Wisdom and Leith (1969), Davis and Leith (1969), Leith (1970), Trown and Leith (1970) and others.

But in the present investigation, *students with lower anxiety level achieve slightly higher on the criterion test of the programme than the students with higher anxiety.*

This result does not support the result of Bossett and Leith (1967), Davis and Leith (1967), Leith and Davis (1969), Trown and Leith (1970). The findings of these studies showed that anxious subjects were better than non-anxious subjects. But the principle finding of the other experiments cited earlier was that non-anxious (below the median) subjects were better than anxious ones. The result of the present investigation supports this contention.

The results of the present investigation also show that *anxiety and persistence have no significant effect on the performance of a 'programme'*. From this result it can be concluded that in the programmed learning technique anxiety and persistence do not interfere with learning and performance, so it seems reasonable that the use of programmed learning materials will cater to the needs of the pupils of different personality traits.

Therefore, programmed learning technique can be heralded as the great solution to the problems of individual differences.

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Professional Attitudes of Teachers and their Acceptance of Innovations

Shalini Bhogle

The present paper aims at developing a tool to measure the attitudes of teachers towards the teaching profession and then to compare the teaching attitudes with acceptance of educational innovations by high school teachers and headmasters.

Attitudes of teachers towards the teaching profession has been the subject of many researches and Minnesota Teacher Attitude Inventory (MTAI) was constructed to measure the teacher attitude. It was administered by many research workers like Callis (1953), Coleman (1954), Beamer and Ledbetter (1955), Leads (1956), etc. Later Yee (1967) tested the validity and homogeneity of MTAI. Apart from MTAI, many investigators have developed other tools to study teacher attitude. Sundarrayya and Kulandaivelu (1965) constructed tools to measure attitude of graduate teacher trainees towards teaching profession. Jeffers (1966) compared attitudes of teachers and association leaders towards teaching profession. Yee (1968) studied the interpersonal attitudes of teachers and advantaged and disadvantaged pupils, and Clardy (1969) designed an attitudinal inventory to measure dedication to teaching.

In India, Buch (1970), on behalf of Indian Council of Social Science Research, compiled Indian studies on teacher attitude and observed that attitude towards teaching profession is studied by many M.Ed. and Ph.D. students.

METHOD

The attitudes of teachers towards teaching profession was measured by using a readymade standardized inventory called Teacher Attitude

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Inventory form II. It was developed by North (1961), as one phase of the research project, an analysis of some necessary qualities of teachers. It was supported by a co-operative research programme (1962). It is a 55 item like rt type of scale with 14 subscales, classified into four teacher attitude areas. The four attitude areas and distribution of items in North's scale are:

(1) Attitude towards teacher pupil relation	10
(2) Attitude towards administration	15
(3) Attitude towards Profession	13
(4) Attitude towards Community	17

Of these four areas, the fourth area namely attitude towards community was excluded as it was thought that it was not directly concerned with the school environment or related to the teaching profession. Three items in the area of attitude towards the profession and another three items in the area of teacher pupil relation were further excluded and a list of 32 items was therefore left in hand which was used for the pilot test.

The inventory was accepted almost in the same wordings except one item where wording was slightly changed. The inventory was used to test overall attitude of teachers in the schools and therefore the different areas mentioned above were not considered separately and the complete questionnaire was used to get a common score for the 32 items.

Pilot Test

The sample was 43 teachers and three headmasters from four schools. The scale consisted of a series of items followed by five response categories: strongly agree, agree, undecided, disagree, and strongly disagree. The categories were scored as 1 to 5 for negative statements and 5 to 1 for positive statements. When the data was tabulated it was noticed that almost all positive items appeared to elicit only the strongly agree and agree type of response. As the scale was standardized for a certain sample and was administered to a different sample, it was necessary to take steps to remove this social desirability element from the scale while retaining its status as a standardized inventory. Therefore, a criterion of 5 to 60% desirability for each one of the five categories was decided and all items with a response in the range of 2 to 26 for each category alone were retained. When this criterion was applied to the items it was noticed that another 12 items had to be rejected. This left only

20 items in the scale. Since the intention was to find the general attitude of teachers towards teaching and not separate attitudes towards the profession, administration, community and pupils as in the original scale, it was felt sufficiently long to enable one to find out the general attitude. And therefore the 20-item scale was accepted for the final study. The possible range of scores therefore was 20 to 100. The range obtained was 32 to 59 with a mean of 45 and S.D. of 6·4.

Validity and Reliability

The scale is borrowed from a standardized inventory. Therefore no external criteria were applied to find the validity of the test. The criterion of 5 to 60% desirability for each response category helped to maintain the internal consistency. The reliability of the scale was calculated by split-half method. The 'r' value was found to be +0·69 and the standard error $\pm$0·082. This scale was used to measure attitude of teachers and headmasters towards the profession.

Final Testing and the Results

The sample for the final study was 30 headmasters and 320 teachers from the cities of Hyderabad and Secunderabad. The sample was randomly selected and fairly represented the population of schools in the area. Two of the items were consistently not answered by the headmasters since they (the items) were more concerned with the teacher. These related to items on time-table and on expectations of the headmaster. (Appendix I). Hence these two were not scored for the sample of the headmasters, the possible range therefore was 18 to 90 and the actual range was 46 to 72. Following is the distribution of the scores of the headmasters:

TABLE 1

	Range and Scores										
	46–48	49–51	52–54	55–57	58–60	61–63	64–66	67–69	70–72	*M*	*S.D.*
No. of headmasters	3	5	1	7	5	5	0	2	2	56·3	6·7

When the scores of the 320 teachers were analysed, the following distribution was observed.

TABLE 2

	Range and Scores													
	30 34	*35 39*	*40 44*	*45 49*	*50 54*	*55 59*	*60 64*	*65 69*	*70 74*	*75 79*	*80 84*	*85 89*	*M*	*S.D*
No of teachers	2	2	2	25	50	62	85	60	27	8	1	1	61·15	8·21

Comparing the two samples it appears that the mean and the S.D. of the teachers sample is higher than that of the headmasters.

Acceptance Innovation

The acceptance of innovation was studied at two different levels, that of the headmasters and that of the teachers, because the headmasters would accept an innovation in the capacity of a headmaster and the teachers in teacher's capacity. Naturally, the same tool cannot study or measure their acceptance. For example, an headmaster may take a certain decision which usually gets approved by the management (in some schools it may be the other way) and the teacher, but not all the decisions of assistant-teachers would be approved by the headmaster and the management. Hence two separate scales were constructed to measure:

(1) Adoption of innovations by headmasters; and
(2) Psychological readiness to accept innovations, or innovation proneness scale for teachers.

Choice of Innovation

A set of five innovations was selected to measure the acceptance of innovation. These innovations had to be top-fed because the preliminary talks with the different school headmasters indicated that there was very little common in these schools. Firstly, there was hardly any innovation introduced which could be called as innovation (here innovation was defined as any thought, action or behaviour which is qualitatively different from the existing ones), and secondly where some innovations did exist, they could not be matched and therefore could not be uniformly measured by a common tool.

These five innovations were actually chosen from the hundreds of circulars sent to all the schools that were under the control of the Director of Public Instruction. These were issued during the period

of 1956 to 1966, and had reached all the schools in the sample area. These were also approved for the present study by a panel of judges.

Acceptance of Innovation Scale for Teachers

Innovation scale for teachers was constructed on the assumption that it will consist of four stages, need, awareness, interest and attitude. These four stages were accepted from Singh and Pareek (1967), who had set up an adoption paradigm made up of seven stages; need, awareness, interest, deliberation, trial evalution and adoption. The fourth stage 'deliberation' was modified to 'attitude'. The next three stages are beyond the scope of an individual assistant teacher in a school. A person with a high score on this innovation scale was considered as one who is likely to adopt innovations if he had the opportunity to do so.

The Tool

A scale of sixty items was finalised after two pilot tests. These sixty items were framed in the following manner: three items (Positive, negative, neutral) for each stage (need, awareness, interest, attitude), and for each of the five innovations ($5 \times 4 \times 3 = 60$). The teachers had to say 'agree' or 'disagree' for each of the statements. The 'agree answer' for a positive item was scored as +1, and the 'disagree answer' for a positive statement was scored as —1. The neutral items were not scored. Thus the probable range of scores was —20 to +20.

The table shows the distribution of scores of the 320 teachers in the sample.

TABLE 3

	—8 to —10	—5 to —7	—2 to —4	—1 to +1	+2 to +4	+5 to +7	+8 to +10	+11 to +13	+14 to +16	+17 to +19	*M*	*S.D.*
No. of Teachers	6	11	16	33	38	61	58	62	35	5	6·74	6·10

Adoption of innovation scale for headmasters

The adoption of innovation scale for headmasters was adopted from Rogers (1965). It consisted of five stages namely awareness,

interest, trial, evaluation and adoption. The scale required the headmaster to state the year in which he first (1) heard of the innovation, (2) was interested in the innovation, (3) tried the innovation and (4) adopted the innovation for the school.

Scoring

The headmaster's score for adoption of innovations was found out by giving percentile scores. This method, in addition to being easy, gives weightage to the number of adoptions, earliness of adoption and difficulty of adoption. The 30 schools in the sample were given separate percentiles scores for the five innovations and later an average percentile score was calculated for each school.

The Headmasters Study

The adoption score obtained for the headmaster was converted into percentile scores and the headmasters were ranked for adoption of innovations.

The attitude scores were similarly ranked and a rank difference co-efficient of correlation was calculated. The 'r' value was found to be +·4869 S.E. ±0·0013. This value is significant beyond 1% level of significance and shows that there is a high correlation between teaching attitude and adoption of innovation by the headmasters.

Teacher's Study

The teachers sample was treated with the product moment co-efficient of correlation since the sample was large (N=320). The value of 'r' was found to be +0·1834 S.E.=±0·0537. This shows that there is a very low but positive correlation between acceptance of innovations by the teachers and their attitude towards the teaching profession.

DISCUSSION

While any number of studies on measuring professional attitudes of teachers and on adoption of educational innovations by headmasters and teachers were available, there was only one study by McDonnel (1969), which correlated professional attitudes of teachers with acceptance of innovation. However, the high significant positive r value for the headmasters sample and a fairly good correlation in the teachers sample do suggest that the attitude towards the teaching profession

should be an important variable in studies on adoption of innovations. Whenever a teacher shows readiness to accept innovation in the educational system it indicates that his general bent of mind is for improvement in education and therefore, he is also favourably disposed towards the teaching profession. The results obtained are also in the expected direction.

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Classroom Interaction Analysis:* A Report of Research and Training in India

T. Venkateswara Rao

Prayag Mehta

While reviewing the work done so far both in the fields of training and research, the authors foresee the prospect of application of Interaction Analysis beyond classroom situations.

The systematic interest shown by Educational Psychologists in India on the subject of classroom interaction dates back to 1963 when Mehta prepared a manual on Classroom Behaviour and circulated it to teachers and others interested in this area. This was later published by National Council of Educational Research and Training (Mehta, 1968). It describes classroom interaction in terms of Dominative and Integrative Behaviour and stresses the importance of verbal behaviour in increasing innovativeness and producing effective classroom climate. These early efforts stimulated further interest in this area. The first summer institute for college teachers of educational psychology, organised jointly by the National Council of Educational Research and Training and the University Grants Commission in 1965, contained group processes in education as one of the three major areas (Mehta, 1965). Mehta organised the first Indian Laboratory on Achievement Motivation (LAM) for teachers and educators in 1966. It was designed to change teacher's classroom behaviour along the integrative dimension. Both the summer institutes and the LAM, later became national programmes

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leading to an extensive diffusion of new ideas. Details of these programmes are described below.

LABORATORY IN ACHIEVEMENT MOTIVATION

This programme with a duration of 10 days had two major objectives:

1. To increase the motivation level of teachers by inculcating or increasing in them the need for achievement (McClelland, 1966); training them in goal setting behaviour, etc., and,
2. To help participants understand and develop suitable classroom and instructional behaviour with a view to develop more effective influence strategies as well as with a view to create friendly and warm teaching-learning climates.

As the objectives indicate this programme was specially designed to increase educators' and teachers' concern to achieve, and to help them change their classroom behaviour along integrative dimension with a view to develop friendly integrative and motivating classroom climates. A typical 10-day laboratory devoted 3 to 4 full days to understanding and changing classroom behaviour. Mehta and his associates have organised several such laboratory courses since 1966, covering teachers and educators spreading all over the country. The pertinent data are shown in Table 1.

TABLE 1

Laboratories on Achievement Motivation Conducted by Mehta and his associates with Interaction Analysis inbuilt in the models.

S. No.	*Year*	*Place*	*No. of Teachers Trained*
1.	1966	Jaipur	11
2.	1967	Nagpur	16
3.	1967	Patna	17
4.	1968	Udaipur	14
5.	1968	Jodhpur	14
6.	1968	Turki	16
7.	1969	Horhat	16
8.	1969	Anand	19
9.	1969	Kundeshwar	12

Thus altogether about 135 teachers were trained in interaction analysis by Mehta's group alone during the period of about 3 years. Some of

these training programmes included carefully designed experimental studies attempting to measure the influence of the training on the experimental group of teachers and the influence of the changed teacher behaviour ou the students. The results of the first experiment of its kind and its follow up have been published (Mehta, 1969; Mehta and Kanade, 1969 and Mehta and Dandia, 1970). The objectives of these programmes did-not exclusively concern with interaction analysis. It however formed the core of the programme with feedback on interaction analysis serving as an instrument for changing teacher behaviour. Course contents of a typical programme of this kind ranging over 10 days is described below in Table 2.

TABLE 2

		I Day	
Session- 1	Test of imagination	Session- 2	Who am I
Session- 3	Who am I	Session- 4	Day's evaluation.
		II Day	
Session- 5	Feedback	Session- 6	Concept session on motivation.
Session- 7	Criteria of achievement motivation.	Session- 8	Evaluation of day's work.
		III Day	
Session- 9	Feedback	Session-10	Block building game.
Session-11	Classroom behaviour, role plays, concept of direct and indirect influence.	Session-12	Categories of classroom behaviour, practice with role plays and observation.
Session-13	Scoring of stories: scoring for A.I.	Session-14	Day's evaluation.
		IV Day	
Session-15	Feedback	Session-16	Ring toss game.
Session-17	Discussion of ring toss game	Session-18	Sub categories of achievement motivation: a brief concept session.
Session-19	Scoring of sub-categories.	Session-20	Evaluation of day's work.
		V Day	
Session-21	Feedback	Session-22	Model story writing.
Session-23	Help giving and help seeking role plays.	Session-24	The life goal inventory.
Session-25	Evaluation.		

TABLE 2 (*contd*)

VI Day

Session-26	Feedback	Session-27	Metrix Interpretation Practised.
Session-28	Motivation Scoring, Self-test for further training.	Session-29	Creativity and Decision making.
Session-30	Achievement Plan Inventory	Session-31	Evaluation of Day's work.

VII Day

Rest

VIII Day

Session-32	Feedback	Session-33	Achievement work inventory.
Session-34	Discussion of some achievement plans.	Session-35	The life goal inventory.
Session-36	Discussions on the life goal inventory.	Session-37	Evaluation.

IX Day

Session-38	Feedback	Session-39	Thinking about school programmes.
Session-40	The school programme	Session-41	Discussions on the reports of the small groups with regard to the objectives and the various items of the programme.

X Day

Session-43	Feedback	Session-44	Implementing the programme
Session-45	Solving practical difficulties and the mechanism for implementing the programme.	Session-46	The Overall Evaluation and Valedictory.

These programmes seek to help teachers develop more effective behaviour in their classrooms by making them aware of the feelings of their pupils and the consequences of using different ways of influencing pupils. Each individual teacher examines his classroom behaviour with particular reference to the integrative classroom behaviour and the consequence of using integrative behaviour on pupils. Besides learning to identify dominative and integrative patterns of classroom behaviour, the participant experiments in a flexible way with a variety

of influence patterns to learn better ways of influencing his pupils. As behaviour modification is a complex process involving many other factors, these training programmes also concentrate on other related aspects of classroom dynamics. As could be seen from the programme inputs from Table 2 these essentially center round increasing the awareness in the teacher of his own needs, values, motivational patterns and problem—solving, goal-setting behaviour and, use essentially the projective measurement teachniques and objective feedback system. Trust-building exercises, goal-setting exercises, role plays and achievement imagery boosting exercises are the special features of the programme.

Summer Institute in Motivation Learning and Group Processes in Education

While the LAM (Laboratory in Achievement Motivation) is designed to change teacher behaviour, the summer institute programme, as mentioned above, is to refresh and supplement the subject matter knowledge in three specific areas—namely motivation, learning and instructional group process for college lecturers in educational psychology. So far seven such institutes have been organised in different parts of the country covering some 200 teacher-educators and other lecturers. This institute is organised annually by the NCERT.

Diffusion of Ideas and Practices concerning Classroom Interaction

The LAM and the summer institutes have thus covered some 350 key educators, teachers and teacher-educators from every corner of the country. Some of such participants took up subjects related to interaction for their Ph.D. degree work; some organised courses at the school level to orient their teachers to this idea; some published papers and newspaper articles on the subject, thus diffusing the related ideas far and wide in the educational system in the country. Mehta's *Understanding Classroom Behaviour* has been translated into several Indian languages and some 40,000 copies have been circulated among teachers and others, free of charge by the various extension agencies. Besides the NCERT, another institute which has been playing a notable role in this respect is the Centre for Advance Study in Education (CASE), M.S. University of Baroda. The CASE has been set up by the University Grants Commission to conduct advance studies in Education. The centre has organised two national conferences on the subject. It has initiated a massive national co-operative programme in this respect, stimulating hundreds of teachers and researchers to work in this area.

SOME NOTABLE RESEARCH

Another significant attempt in this direction was made in research study financed by the Indian Council of Medical Research and conducted by Pareek and Rao at the National Institute of Health Administration and Education. The results of this study are now available in a report from (Pareek and Rao, 1971). Perhaps this is the first systematically conducted large scale research-cum-training project on Interaction Analysis in India to be available in a complete report form. In this study a 10-day training programme was conducted to modify the classroom interaction behaviour of grade V teachers. Both experimental and control groups of teachers were observed before training and at various intervals after training. The training exclusively attempted to provide feedback to the teachers on their classroom behaviour patterns and made use of role plays as well as actual classroom practice exercises to experiment with various patterns of interaction behaviour. The programme used in this study is described in Table 3 below.

TABLE 3

Teacher's Classroom Interaction-Behaviour Modification Programme used by Pareek and Rao (1971)

Day	*Forenoon*	*Afternoon*
Ist day	Who am I ?	Values and norms in classrooms.
IInd day	Interaction and classroom climate	Teacher influence and teaching styles.
IIIrd day	Recording interactions: Flander's technique.	Practice in the use of categories.
IVth day	Practice in recording and achieving speed.	Practice in schools.
Vth day	Practice in schools.	Practice in Schools.
VIth day	Practical: Matric preparation, reliability etc.	Practical: Matric preparation-reliability etc.
VIIth day	Discussion of results of research on Interaction patterns of teachers in Delhi.	Feedback and plans for self-improvement.
VIIIth day	Experiment in self change; role playing.	Practice in schools
IXth day	Practice in schools (changed behaviour).	Discussion.
Xth day	Discussion	Review and evaluation: closing session.

Post-training observations collected upto a period of 6 months after training indicated that the experimental group of teachers changed their behaviour from dominative to integrative type and maintained it consistently. Significant changes (as found by median tests) were observed in Flanders' categories 2, 3 and 4 where the frequencies increased. As a result of training no significant changes were observed in T/S ratios where as the I/D as well as i/d ratios improved significantly. The details of the results are reported elsewhere (Pareek & Rao, 1971 a).

Two more training programmes based on studies on interaction analysis deserve mention here include the ones by Biswanath Roy (1970) at the National Council of Educational Research and Training and by Desai (1970) at Sardar Patel University. Both these studies made use of "feedback on interaction analysis" as the basis for training teachers and the final reports are expected to appear soon. While the first of these studies attempted to compare the effectiveness of different methods of feedback (among which feedback using interaction analysis is one) on the behaviour modification of teachers (Roy, 1970), the second study attempted to evaluate the impact of using verbal and nonverbal incentives in classroom interaction (Desai, 1970).

While this is the trend of training activities on interaction analysis in India, research in this field which started in a slow motion around 1965 with Mehta's studies, has gained momentum and has surpassed the training programmes in the past two years. Significant contribution to research in this area has been made by M. B. Buch who was originally heading the Department of Field Services at NCERT and later became the Director of the Centre for Advanced Study in Education (CASE) at the M.S. University, Baroda. Since 1970, Professor Buch has been concentrating his efforts on increasing the research turnout on Interaction Analysis at the Centre for Advanced Study in Education. The Centre has a separate cell on interaction analysis with a few Doctoral fellows working on this subject and has so far conducted a number of research studies in this area. Some of these research studies have appeared in a book entitled *Communication in Classroom* edited by Buch and Santhanam (1970). The studies reported in this book include interaction studies on Baroda teachers by Buch, Santhanam, Qurashi and Lulla, and on Delhi teachers by Pareek and Rao. Of these, the study on Delhi teachers was reprinted from a journal (Pareek and Rao, 1970), and this was perhaps the first research article to be published in India

on Interaction Analysis. It was presented first at Indian Science Congress held in January, 1970.

Some Results From These Studies

The four studies reported in the book focused on interaction patterns of teachers as measured by Flanders 10 category system. While the first three studies were conducted at CASE and are on secondary school teachers, the last one was conducted at the National Institute of Health Administration, New Delhi and was on primary school teachers handling single teacher classes and thereby teaching all subjects. The findings reported in these studies are briefly described here.

Interaction Patterns of Delhi Teachers

The study by Pareek and Rao was conducted on 50 V grade teachers of Delhi drawn from 50 primary and middle schools. Each teacher was observed for about three half-hour periods and a total of 84,087 observations were collected. The results revealed that about 55% of the time was spent in teacher talk. As compared to the 2/3 figure given by Flanders (1962), or that of the 59% reported for American teachers and 83% reported for New Zealand elementary school teachers (Flanders, 1962 a), the Delhi teachers seem to talk less in their classrooms. Student talk was found to take care of about 31% of the available time while about 14% of the time was found to be spent in confusion and silence. As compared to 18% and 13% of the time spent by Minnessota and New Zealand teachers respectively in accepting and clarifying ideas, praising and encouraging the students, Delhi teachers were found to spend only 8% of the time in such activities. Comparatively much time (62% of their talk) was spent by Delhi teachers in lecturing than by U.S. or New Zealand elementary school teachers (49% and 42% respectively). In about 67% of the periods observed these teachers used direct influence acts about twice the time (or more) they used the direct influence. Chi-square computed between I/D ratios (original) and T/S ratios showed a significant association between the two. No sex difference was found in this study. A percentage matrix of this study taken from the report is presented in Table 4 to give better idea of the results. Interestingly the results of this study are in sharp contrast with the results of the other three studies on secondary school teachers reported in the book edited by Buch.

TABLE 4

Percentage of observations falling in each cell of the 10×10 matrix of Flander's Categories for 50 primary school teachers of Delhi

Category	1	2	3	4	5	6	7	8	9	10
1	·003	0·00	0·00	0·00	·010	·007	0·00	0·00	0·00	·007
2	0·00	·488	·138	·153	·209	·114	·035	·305	·277	·142
3	0·00	·488	1·190	·044	·040	·066	·072	·360	·188	·152
4	·003	·216	295	2·820	1·595	·738	·166	1·547	661	·675
5	·007	·154	·436	·393	30·975	·730	·143	·547	·903	·614
6	·007	·148	·136	·512	·657	1·876	·236	·655	·511	·635
7	0·00	·003	·039	·116	·109	·238	·816	·215	106	·149
8	·007	·088	·056	2·410	·305	·632	·136	13·685	·466	·322
9	0·00	107	·096	1·746	415	·375	·047	1·380	8·007	·260
10	0·00	·133	·214	·647	·587	·563	·138	·331	·336	12·072
Total	·027	1·825	2·600	8·841	33·902	5·404	1·789	18·025	11·455	15·093

Percentages reported in this table are the averages from the percentage matrices of different teachers and hence show slight variations from those reported in Pareek & Rao, 1970.

Interaction Patterns of Baroda Teachers

The study by Buch and Santhanam was made on " teachers teaching English to class VI to X in Baroda ". A total of 14,786 observations were collected in about 10 hours and 7 minutes. The results revealed that 69% of the time was spent in teacher talk and 21% in student talk and, only one-fifth of the teacher talk was indirect (revised I/D ratio=0·2). Nearly one-seventh of the student talk was self-initiated whereas in the study by Pareek and Rao it was about four-fifths. Perhaps the only figure that is comparable to some extent in both these studies seems to be the time spent in silence and confusion which is about 10% in this study and about 14% in the one by Pareek and Rao. The percentage matrix of this study is reproduced here in Table 5 to provide more data to the interested reader.

TABLE 5

Percentage Matrix for 11 English Teachers from Baroda
(Buch and Santhanam, 1970)

	1	2	3	4	5	6	7	8	9	10	Total
1.	0·05	.	..	0·01	0·05	..	0·01	..	0·01	0·01	0·14
2	.	0·65	0·18	0·24	0·40	0·16	0·03	0·39	0·31	0·30	2·66
3.	.	0·06	0·59	0·44	0·97	0·18	0·01	0·10	0·11	0·23	2·69
4.	..	0·13	0·01	2·64	0·33	0·23	0·06	2·41	0·78	1·79	8·38
5.	0·05	0·31	0·01	2·19	44·35	0·67	0·10	0·76	0·36	1·41	50·21
6.	..	0·06	0·07	0·36	0·62	0·72	0·20	0·98	0·10	0·72	3·83
7.	..	0·05	..	0·07	0·14	0·20	0·64	0·08	0·03	0·22	1·43
8.	0·01	0·72	1·21	0·78	1·26	0·95	0·21	12·01	0·03	0·73	17·91
9.	0·03	0·46	0·56	0·30	0·37	0·19	0·03	..	1·17	0·14	3·25
10.	..	0·22	0·06	1·35	1·72	0·53	0·14	1·18	0·35	4·04	9·59
Total	0·14	2·66	2·69	8·38	50·21	3·83	1·43	17·91	3·25	9·59	100·09

A I/D Ratio=0·200 (Columns 1 to 4/Columns 1 to 7).
B Revised i/d Ratio=0·502 (Columns 1 to 3/Columns 1 to 3+6 and 7).
C Extended Indirect=1·53 (Sum of Cells 1—1, 1—2, 1—3, 2—1, 2—2, 2—3, 3—1, 3—2, 3—3).
D Extended Direct=1·76 (Sum of Cells 6—6, 6—7, 7—6 and 7—7).
E 3—3 Cell Frequency=0·59 per cent.
F 9—9 Cell Frequency=1·17 per cent.
G Teacher Talk=69·29 per cent.
H Student Talk=21·16 per cent.

The study by Buch and Qurashi was conducted on 17 male social studies teachers of secondary schools in Baroda. A total of 19·135 observations were collected. Surprisingly the teacher talk in this study was found to be nearly 83%, with about 10% student talk and 7% silence and confusion. The mean I/D ratio was 0·17, even less than the earlier one of 0 20. The percentage tallies matrix is reproduced in Table 6.

TABLE 6

Percentage Matrix of 17 Male Social Studies Teachers from Baroda
(Buch and Qurashi, 1970)

	1	2	3	4	5	6	7	8	9	10
1.	.	..	..	..	..	..	..	..	..	·01
2.	..	·08	·08	·02	·09	0·01	·005	·05	..	·02
3.	·005	·03	1·94	·16	·50	·02	·005	·45	·005	·46
4.	..	·005	·03	3·00	·49	·13	·04	3·75	·05	·81
5.	..	·04	..	3·11	62·51	·36	·06	·07	·07	·91
6.	..	..	·01	·15	·30	1·34	·99	··10	..	·32
7.	..	..	·005	·07	·13	·03	·57	·06	..	·08
8.	..	·19	1·29	1·46	1·46	·16	·07	4·88	·03	·53
9.	..	..	·02	·02	·11	·005	·005	·01	·22	·03
10.	·005	·005	·20	·77	1·09	·27	·09	·68	·05	4·21
Total	·01	·35	3·58	8·76	66·68	2·33	0·94	10·05	·43	7·38
		12.65				69·95		10·48		

Teacher Total 82·65% Student Total 10·48% Silence Total 7·38%.

A I/D Ratio = ·17 (Column 1-4/Column 5-7).
B i/d = 1 Column 1-3/Column 6-7).
C Extended Indirect = 2·14 (Sum of Cells 1—1, 1—2, 1—3, 2—1, 2—2, 2—3, 3—1, 3—2, 3—3).
D Extended Direct = 2·03 (Sum Cells 6—6, 6—7, 7—6, 7—7).
E 3—3 Cell = 1·94.
F 9—9 Cell = ·22.
G Teacher Talk = 82·65.
H Student Talk = 10·48.
N.B.—Total of Rows and Columns may not be the same because of rounding up of Figures.

In the third study, Santhanam, Qurashi and Lulla observed 19 women and 17 men social studies teachers in Baroda. A total of 41,306 observations were collected. The results revealed that women teachers talked about 75% of the time while men teachers talked about 82% of the time. Students of women teacher classes were found to talk for about 13% of the time while of the men teachers talked only about 10·5% of the time. Self-initiated talk by the students was only 2·4% (in women teacher classes) and 4% (in men teacher classes) of the total student talk.

The results of the studies at Baroda secondary schools drastically differ from those found by Pareek and Rao (1970, 1971) and pose such questions as why the secondary school teachers talk more than the primary school teacher, what influence do they exert on their students and so on, which are yet to be answered. Within country differences seem to be much more than between country differences in the classroom interaction patterns of teachers.

Teacher behaviour and student mental health

The Pareek and Rao study (1971) raised other interesting questions which deserve mention here. This study on "Motivation Training for Mental Health" attempted in the first part to find out the association between Flanders I/D, i/d, T/S (original unmodified) ratios of teachers and the positive mental health variables of students such as their adjustment, initiative, class-trust, activity level, intelligence, reactions to frustration and sociometric choice levels. The results revealed that teachers with high I/D ratios had significantly more number of students well-adjusted, high in intelligence, high initiative taking and giving more inpunitive and ego-defensive but less need-persistant reactions to frustration as compared to students of Low I/D teachers. However, when the associations (Chi-squares) were worked out low i/d ratios teachers were found to have significantly more number of students well-adjusted, high in intelligence, and giving less extrapunitive and intropunitive but more impunitive reactions to frustration. Other variables did not reveal any significant associations. Surprisingly when the training programme was conducted using feedback methodology and without giving the teachers any other inputs such as the desirability of integrative teaching a raise was found in both their I/D as well as i/d ratios without any significant change in T/S ratios. Though originally the study was designed to find out the impact of this changed behaviour

of the teachers on the positive mental health variables of the students, it could not be completed due to some interferences such as the examinations of the students and changing of the teachers. However, an attempt in this direction using some of the tests developed in this study (Pareek *et al* 1970) has been made by Mehta in the Jodhpur training programme. The results of this study indicated that experimental group of teachers (these were also V grade teachers) who changed the behaviour after training were found to influence their students in terms of developing more trustful atmosphere in the class and so on. Here the teachers were trained to change their interaction behaviour from dominative to integrative type. (Mehta 1973, 1974).

FUTURE PERSPECTIVES AND SOME TRENDS

Besides concentrating its efforts on conducting research in the area of Interaction analysis the Centre for Advance Study in Education is attempting to popularise this technique in educational cricles by holding national seminars, appreciation programmes, short-term courses and conferences. The training programmes conducted by this organization mainly attempt to train researchers from training colleges and education departments in this technique so that they will be able to organise behaviour modification programmes and conduct research. The ultimate aim appears to be to collect nation-wide data.

Attempts are also being made by researchers in this area to modify Flanders' categories to suit different purposes. One such modification of Flanders' categories has been made by Pareek and Rao (1971) in their study to suit observing primary school teachers. This was so because there are certain typical patterns of behaviour exhibited by primary school teachers which warranted altogether different category system. The need for developing new category systems has been strongly brought out by Jangira (1971) in a paper presented at the First National Seminar on Interaction analysis held at CASE in January 1970.

A co operative project on Productive Teaching (COPPT) was initiated by M. B. Buch at CASE which is a nation-wide project being collaborated by a number of teacher educators, educational psychologists and teachers all over India. This project attempts to take up studies in the area of interaction process analysis and classroom communication and also to make use of the results thus collected in teacher behaviour modification programmes. There are so far about 75 to 100 researchers from

different parts of India working on this area. The third national seminar on interaction analysis was held in Baroda in January, 1972 where a number of issues regarding dynamics of instructional behaviour were discussed in the context of interaction analysis.

With Mehta, shifting to Udaipur University, another centre for research in interaction analysis may emerge at Udaipur. Already doctoral students are being enrolled to work on topics related to classroom dynamics and interaction analysis.

Suggestions have already been made for introducing interaction analysis into the internship programmes of training colleges and in evaluating teaching effectiveness (Rao, 1971). With the growing interest and insight into classroom dynamics, research on interaction analysis tends to extend to developing new category systems, application of interaction analysis to areas such as programmed instruction, institutional environments, political behaviour and communal riots and interpersonal dynamics. Thus interaction analysis studies seem to suggest expanding and exciting possibilities in the fields of research, programme development and training in India.

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Language Development of Kindergarten Children in Relation to their Paternal Occupations

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This exploratory study was undertaken to find out the extent to which disadvantaged children differed from advantaged ones in their language development at a time when they were ready to enter the primary school. The sample consisted of 55 kindergarten children whose fathers came from different occupational strata. The technique used was story narration. The results showed that differences between the children were not significant with regard to the number of words used but in the case of recall of sequences, quality of language used and degree of comprehension, significant differences were obtained between the extreme groups.

Research evidences show that language development of young children are vitally affected by the environment in which they live. Environmental enrichment in terms of quality and quantity of parent-child interaction, good language models and exposure to reading material begins to exercise an influence right from the early years. Most of the research on disadvantaged children has consistently shown that

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environmental deprivation leads to language retardation in children. Disadvantaged children are likely to have a lower vocabulary score (John 1963, and Kennedy 1969), to speak in shorter sentences (John 1963) and to use less number of words and sentences in narration (Milgram, Shore, and Malasky 1971). Bernstein (1961) however pointed out that disadvantaged children find it more difficult to integrate rather than to enumerate or label; that their language is more restricted and that they are less capable of using an elaborate code of language for communication.

The present investigation has taken the paternal occupation as a rough index of environmental enrichment or deprivation. It is assumed that in general the higher the paternal occupational level, the greater is the environmental enrichment. The task that was selected in determining the child's language development involved retelling in the child's own words a story that was narrated to him. This test was chosen on the thesis that verbal behaviour with reference to a particular subject matter would be more likely to reflect stable trends than spontaneous remarks or casual conversation (Milgram *et al*, 1971). Moreover for the KG class, the task is a familiar one as story narration is a part of the regular routine of the class. The present study however differed from that of Milgram's in that it did not take the support of pictures for the narration of the story. Milgram while summing up said that though his study attempted to verify Bernstein's hypothesis that disadvantaged children are more handicapped with the integrative aspects of language (thematic) rather than the enumerative aspect (number of words, etc.), his test was perhaps not an adequate one because illustrations were available to children as they were told the story. Milgram was of the view that perhaps his results did not go in line with Bernstein's hypothesis because the illustrations provided concrete and mnemonic cues more to disadvantaged children than to advantaged ones. The present study therefore took the precaution of avoiding use of illustrations for story narration.

The fathers of the children in the present study were from different occupational levels, varying from professionals to unskilled workers. Yet they sent their children to the same school mainly because they had confidence in the school and secondly because of the proximity to the residence. It is the school's policy to take special efforts, particularly in the case of disadvantaged children, to help them in their development. We were therefore interested in determining how far these efforts were

successful and to what extent the disadvantaged ones differed from the advantaged children at a point when they were ready to leave the nursery school and enter the primary school. It was decided to study the differences in language development between them as much of the success in the early primary school depends on the child's facility in language.

Objective of the Study

The objective of the investigation is to study the relationship between language development of Kindergarten children and their paternal occupations.

Sample

The sample was drawn from a New Delhi urban nursery school. The paternal occupations of the sample ranged from professionals to unskilled workers. The sample consisted of 55 Kindergarten children, 24 girls and 31 boys with a mean age of 5 years 7 months. The study was done in March when the children had almost finished the academic programme and were ready to go to class I. All the children in the sample did have at least two years of pre-schooling; some had even three.

Procedure

A suitable story that would be of interest to the KG children was chosen. The story had enough action in it and if it was divided into sequences, the total number of sequences added up to 7. The total number of words used in the story was 250. Care was taken to see that no word that was unfamiliar to the children was used. The story was written down and was narrated to the children individually. The narration was done by the teachers in charge of the groups. The responses of the children were taken down verbatim.

The responses were scored as follows: (1) total number of words used, (2) number of correct sequences given, (3) quality of language used; and (4) degree of comprehension. To determine the quality of language, a five point rating scale was used ranging from excellent to very poor; the score given ranged from 5 to 1. To arrive at the degree of comprehension, a three point scale was used with full comprehension being given a score of 2, partial comprehension a score of 1, and no comprehension a score of 0.

RESULTS

1. *Number of words used in the story*

Table 1 gives the mean number of words used in the story by the different groups of children and the standard deviations.

TABLE 1

Means and SDs of the number of words used

	Paternal Occupations of Children				
	Professional	*Supervisory*	*Clerical*	*Skilled*	*Semi-skilled and unskilled*
N	11	5	14	11	14
Mean	94·27	88·6	88·5	77·82	70·21
SD	25·43	44·2	33·41	37·73	42·08

TABLE 2

Significance of mean differences between the different groups

Paternal Occupations	*Supervisory*	*Clerical*	*Skilled*	*Semi-skilled and unskilled*
Prof.	·27	·48	1·19	1·78
Super.	..	·004	·47	·81
Cle.	..	..	·73	·47
Sk.	..	..	..	1·27

Tables 1 and 2 show the trend that the mean number of words used decreases as the paternal occupation changes from professional to unskilled work. Yet the differences do not reach the level of significance, because of the high variations within the groups.

2. *Number of correct sequences*

Table 3 gives the mean number of correct sequences given by the different groups of children and the standard deviations.

INDIAN EDUCATIONAL REVIEW
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TABLE 3

Means and SDs of correct sequence

	Paternal Occupations				
	Professional	*Supervisory*	*Clerical*	*Skilled*	*Semi-skilled, and unskilled*
N	11	5	14	11	14
M	6·82	6·40	6·36	4·91	4·36
SD	·40	1·34	1·00	2·66	2·82

TABLE 4

Significance of mean differences between the different groups

Paternal Occupation	*Supervisory*	*Clerical*	*Skilled*	*Semi-skilled and unskilled*
Prof.	·69	1·59	2·36*	3·24†
Super	..	·06	1·49	2·12*
Cle.		.	1·73	2·50*
Sk.	..	..	..	·39

*Significant at ·05 level.
†significant at ·01 level.

Tables 3 and 4 show that the number of correct sequences given by children decreases as the paternal occupational level changes from professional to unskilled work. The children of semi-skilled and unskilled workers give significantly less number of correct sequences than the children of professional, supervisory and clerical workers; the difference between the children of skilled and unskilled workers is not significant. The only other significant difference is between the children of professional and skilled workers. In other cases the differences are not significant but a persistent trend is seen that as paternal occupational level decreases, correct sequences given by children also decreases.

3. *Quality of language used*

Table 5 gives the mean scores and standard deviations of the quality of language used by the different groups of children.

TABLE 5

Means and SDs of the quality of language used

	Paternal Occupations				
	Professional	*Supervisory*	*Clerical*	*Skilled*	*Semi skilled and unskilled*
N	11	5	14	11	14
M	4·18	3·2	3·93	3·18	3·00
SD	·75	1·49	·83	1·25	1·41

TABLE 6

Significance of mean differences between the groups

Paternal Occupations	*Supervisory*	*Clerical*	*Skilled*	*Semi skilled and unskilled*
Prof.	1·40	1·41	2·27*	2·68*
Super	..	1·04	·03	·26
Cle	..	..	1·70	2·11*
Sk	..	..	..	·94

*Significant at ·05 level.

Tables 5 and 6 show that the quality of language used improves as the occupational level of fathers increases. The differences attain significance between the children of professionals and those of skilled and semi-and un-skilled workers. There is also a significant difference between the children of clerical workers and those of semi- and unskilled workers. The differences between the other groups do not attain the level of significance.

4. *Degree of Comprehension*

TABLE 7

Mean comprehension scores and standard deviations for the different groups of children

	Paternal Occupation				
	Professional	*Supervisory*	*Clerical*	*Skilled*	*Semi-skilled and unskilled*
N	11	5	14	11	14
M	2·00	1·80	1·86	1·36	1·21
SD	0	·45	·36	·81	·97

TABLE 8

Significance of mean differences between the groups

	Supervisory	*Clerical*	*Skilled*	*Semi-skilled and unskilled*
Prof	1·00	1·46	2·67*	3·05†
Super	..	·27	1·39	1·84
Cle	..	..	1·92	2·44*
Sk.	..	..		·42

*Significant at ·05 level.
†Significant at ·01 level.

Tables 7 and 8 show that the degree of comprehension of children also decreases as the paternal occupational level decreases. Though this trend is shown, this difference attains the level of significance in the difference between the children of professionals and children of skilled workers as well as between professionals' children and children of semi-skilled and unskilled workers. Significant difference is also noted between children of clerical workers and children of semi-skilled and unskilled workers. The differences between the other groups do not attain the level of significance.

DISCUSSION

The results show that though the trend is that language retardation increases as the paternal occupational level decreases, (1) it reaches significance only in the thematic aspects as well as in comprehension and quality of language but not in the enumerative aspects, *viz.*, number of words; (2) the differences are significant only between the children of professionals and the children of skilled and semi- and unskilled workers and also between the children of clerical workers and the children of semi- and unskilled workers; (3) the differences between the other groups are not significant.

The first finding is in support of Bernstein's hypothesis that disadvantaged children have more difficulty with the integrative rather than the enumerative aspect of language. The second finding indicates that it is the children of the semi-skilled and unskilled workers and to some extent, those of the skilled workers who are disadvantaged; not much difference is seen between the children of professionals, supervisors

and clerical workers as far as language development is concerned. They could all be clubbed together in the advantaged group. Children who require support are the children of skilled, semi-skilled and unskilled workers. They need help particularly in the integrative aspect of language as well as in ability to comprehend and communicate in refined language. Poor language models at home and lack of opportunity for development of problem solving skills are likely to be the causes for this retardation.

Milgram's argument that illustrations do give more cues to the disadvantaged and that if the children were required to retell the story without the support of pictures, potentially greater differences in producing thematic material might obtain between the two groups, appears to be true.

We thus found that in spite of the best efforts of the school to enrich the environment of under-privileged children, the children of the lowest paternal occupational level, the semi- and unskilled workers, still differed from the children of professionals in terms of number of sequences recalled, quality of language used and degree of comprehension. Therefore at the point of school entry, the extreme groups persisted to show the differences. However the differences between the other groups seemed to have been more or less ironed out.

Conclusions

1. The general trend is that language retardation increases as paternal occupational level decreases.
2. The differences attain the level of significance in number of sequences repeated, in quality of language used and in the degree of comprehension.
3. The differences are not significant in the number of words used by children to narrate the story.
4. Significant differences are mostly noted between children of professional workers and children of skilled and semi- and unskilled workers and between children of clerical workers and children of semi- and unskilled workers.
5. It is thus seen that in spite of the best efforts of the school, the differences between the professionals' children and children of the skilled, semi- and unskilled workers persist with regard to the sequence recalled, quality of language used and degree of comprehension. However the differences between the other groups are more or less ironed out.

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Student Teacher Classroom Interaction

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In the present study 30 teachers (23 male and 7 female), teaching different subjects in Secondary and Higher Secondary classes were administered personality test (F-scale adopted in Hindi) and verbal interaction in their classes were observed and recorded. Teacher popularity questionnaires were administered to 400 students (321 boys and 79 girls) studying from VIth to XIth classes.

Flander's ten category (1970) system was used in observation of classroom interaction. The hypotheses were tested by F-scale, popularity questionnaire and Interaction Analyses.

The findings recorded here, the author hopes, may have some value for changing teacher behaviour which will promote better classroom climate for effective learning situation.

There is nothing unusual in classroom behaviour. Teachers teach and pupils learn. In the classroom teacher talks, writes on the blackboard, asks questions, supervises the class, reads from the textbook, manages the classroom discipline, etc., while on their part pupils answer, raise their hands, initiate discussion, etc. One may find moments of absolute silence broken by peals of laughter in a classroom. These and many other similar things usually happen in a classroom. In brief whatever a teacher may do in a classroom, his actions arouse reactions in pupils. The teacher and the students are continuously interacting in the class. The teaching-learning process in a classroom is generally not possible without this interaction.

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

Pattern of Teacher behaviour

Teacher behaviour can be described mainly in two patterns: "The Integrative Pattern" and "The Dominative pattern". They behave on different occasions in different ways. All these constitute interaction between the teacher and the pupils. This interaction is the main channel through which the teacher exercises his influence on the students. Some teachers try to dominate the classroom. Students in their presence feel insecure, awed and inhibited. There are others who have a different approach. They are more accepting, tolerant, sympathetic and show little tendency to dominate.

Earlier Work in the Field of Classroom Climate

Classroom climate refers "to generalized attitudes toward the teacher and the class that the pupils share in common in spite of individual differences".[1]

The behaviour of a teacher while teaching has a great influence on his pupils. It is teacher's behaviour which sets the pattern of the atmosphere in the class. H. H. Anderson and his colleagues Helen and Joseph Brewer and Mary Frances Reed[2] had done the earliest systematic studies of spontaneous teacher and pupil behaviour. These are based on the observation of "dominative" and "integrative" contacts.

After a year of Anderson's work[3]—Lippitt and White working with Kurt Lewin carried out laboratory experiments, to analyze the effects of adult influence on groups of boys. Broadly speaking, the pattern which Lippitt and White named "authoritarian leadership" consisted of dominative contacts, "democratic leadership" consisted of integrative contacts, and "Laisser faire leadership" which consisted of irregular and infrequent contacts:

John Withall[4] classified teacher verbal talk into seven categories,

[1]Ned. A. Flanders "*Teacher Influence Pupil Attitudes and Achievement*" U.S. Dept. of Health Edn. and Welfare 1965, U.S. Printing Office.

[2]Ned A Flanders "*Teacher Influence in the classroom*" *RESEARCH ON CLASS-ROOM CLIMATE*, a monograph, The University of Michigan P. 2.

[3]R. Lippitt and R. K. White Social climate of children's group in Barker, R. G. Kounin, J. S. and Wright, H.F. (Eds), *Child Behaviour and Development*, New York McGraw Hill Book Co. 1943, Page 458-508.

[4]John Withall "The Development of a Technique for the Measurement of Social Emotional Climate in Classrooms". *Journal of Experimental Education*, Vol. 17, March, 1949.

which produced an index of teacher behaviour almost similar to the integrative-dominative ratio of Anderson *et al.*

Flanders created laboratory situations in which contrasting patterns of teacher behaviour were exposed to one student at a time. A sustained dominative pattern was consistently disliked by pupils and the reverse trends were noted as pupil reactions to integrative contacts.[5] Perkin[6] using Withall's technique observed that groups of children under an integrative type of leader did greater learning than those groups which were led by a dominative type of leader.

Cogan working with 987 eighth grade students found that students reported performing more assigned and extra school work when they perceived the teacher's behaviour as falling into the integrative pattern rather than the dominative pattern.

Purpose of the Study

The purpose of the study was to categorise teachers' behaviour in the integrative and dominative types and to suggest ways and means to mould teacher behaviour so as to promote better classroom climate for effective teaching and learning.

The crux of the idea is that some acts of teachers increase students' freedom of action while others decrease. The significance of Flander's contribution lies in the fact that he has developed a method by which we can objectively interpret teachers' classroom behaviour and categorize it.

Hypotheses

The major hypotheses were:

1. Teachers of authoritarian personality as judged by the F-scale tend to be dominative in the classroom. They are less liked by students and the students do not feel free in expressing their difficulties to such type of teachers.
2. Non-authoritarian type of teachers are integrative in the classroom. They are more liked by the students and the students feel free in expressing their difficulties.

[5]Ned A. Flander "Personal Social Anxiety as a factor in Experimental learning situations" Journal of *Educational Research Vol. 45*, October, 1951. P. 100-110.
[6]H. V. Perkins "Climate Influences group learnings," Journal of *Educational Research Vol. 45*, October, 1951, P. 100-110.

A review of the related literature revealed that these questions had not previously been answered.

The Method of investigating the Problem

The F-scale was adopted in Hindi and was administered to 30 secondary and higher secondary teachers of both sexes (23 male and 7 female teachers). That they could be assumed as the authoritarian· in the absence of Indian norms it was decided to take the median as the dividing line between the authoritarian and non-authoritarian teachers. In our study sample the authoritarian and non-authoritarian teachers were evenly distributed.

Classroom interaction between students and teachers was observed by the observer (the author himself) for each teacher preferably three times. Flanders' ten category system of interaction analysis (1960) was used in observation of classroom interaction which is given in Table 1.

TABLE 1

Interaction Analysis Categories

Teacher Talk	Indirect Influence	1. Accepts Feeling. 2. Praises or Encourages. 3. Accepts or Uses Ideas of students. 4. Asks questions.
	Direct Influence	5. Lecturing. 6. Giving directions. 7. Criticizing or Justifying authority.
Student Talk		8. Student talk—Response. 9. Student talk—Initiation.
SILENCE OR CONFUSION		10. None of above.

Note: The category numbers are purely nominal; no scale is implied.

The observation technique is known as Interaction analysis in the classroom. Briefly, it consists of classifying verbal talk into ten categories at an average rate of one classification every three seconds. Seven categories are used to classify teacher talk, two categories are used for student talk, and the tenth category is used for silence or confusion. The set of ten categories is assumed to be totally inclusive of all verbal talks heard in a classroom and mutually exclusive since one,

and only one, tally is recorded for a single event observed. The seven teacher categories are divided into indirect teacher talk (categories 1 to 4) which expands the freedom of Student's Participation, and direct teacher talk (categories 5 to 7) which restricts freedom of pupil participation.

Interaction for three seconds is recorded by the observer by writing down one category number for each event so that his record consists of a series of numbers listed in columns which preserve the original sequence of events.

Interaction dates are tabulated in a ten row by ten column matrix, each row and column corresponding to the ten categories. Given a

SECOND

FIRST	1	2	3	4	5	6	7	8	9	10	TOTAL
1											0
2				/							1
3											0
4								/			1
5								/			1
6											0
7											0
8		/								/	2
9											0
10					/						1
TOTAL	0	1	0	1	1	0	0	2	0	1	6

Fig. 1. Initial Tabulation of Sequence Pairs.
(The total of the row will be the same as the total of the columns.)

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

pair of number, the first designates the row, the second the column. A sequence of original events such as 5, 8, 2, 4, 8. The convention we use is to add a 10 to the beginning and end of the series, unless the 10 is already present. Our series now becomes 10, 5, 8, 2, 4, 8 and 10 and is tabulated in the 10-5 cell, the 5-8 cell, the 8-2 cell and the 2-4 cell, and so on.

To know about students' liking of a particular teacher in a class, "teacher popularity questionnaire" (a sociometric type of test) was administered to pupils from classes VI to XI. On this test each pupil was asked to name two popular teachers according to his order of preference. This limited opinion poll helped in locating popular and less popular teachers. Negative choices could not be invited as this would have created problems of indiscipline.

In this study, the classes ranged in size from 17 to 32 pupils per class with an average of 22.

There were 400 pupils in all, of whom 317 were boys (79·25%) and 83 were girls (20·75%), as given in Table 2.

TABLE 2

S. No	*Name of School (All at Bhopal)*	*Number of*		*Percentage of*		*Total percentage of population*	
		Boys	*Girls*	*Boys*	*Girls*	*Boys*	*Girls*
1	2	3	4	5	6	7	8
1.	Kendriya Vidyalaya	163	67	70·87	23·13	40·75	16·75
2.	Demonstration Multi. H. S. School	64	16	80·00	20·00	16·00	4·00
3.	Government Model Multi H. S. School	90	..	100·00	..	22·50	..
	Total:	317	83	..	..	79·25	20·75

N=400

The teachers included in this study consisted of 23 male and 7 female teachers. The personal data variables describing the experience and training of these teachers were spread over a wide range.

The data used in this study were collected from October 1969 to March 1970.

HYPOTHESES TESTING AND STATISTICAL FINDINGS

The hypotheses were tested as follows:

(A) *Personality of Teachers: By F-Scale*

Score points obtained by teachers on administration of F-Scale is given below in Table 3.

TABLE 3

S. No.	*Score points obtained on administration of F-Scale.*	*Score points converted into percentage*
1.	169	83.2
2.	129	63·5
3.	153	75·36
4.	165	81·2
5.	171	85·00
6.	139	68·4
7.	169	83·2
8.	149	73·39
9.	157	77·3
10.	138	67·62
11.	139	68·47
12.	154	75·46
13.	171	85·00
14.	160	78·8
15.	166	81·7
16.	165	81·2
17.	145	71·4
18.	148	72·8
19.	158	77·42
20.	161	79·3
21.	145	71·4
22.	123	60·27
23.	156	76·8
24.	162	79·8
25.	141	69·4
26.	120	59·1
27.	137	67·48
28.	130	63·70
29.	119	58·31
30.	122	60·09
	Median:	74·00

To determine the extent to which teachers are authoritarian type or democratic type the F-Scale results were analysed separately. Regarding

liking of the teachers by students, it was tested by an analysis of teacher popularity questionnaire. It was found that six out of fifteen (40%) authoritarian type of teachers were popular amongst the students; whereas ten out of fifteen (66·6%) democratic type of teachers were found to be popular amongst the students. The Democratic Score points of teachers obtained on administration of F-Scale by reverse scoring is given below in Table 4.

TABLE 4

S. No.	*Score points obtained on administration of F-Scale by reverse scoring*	*Score points converted into percentage*
1.	63	31·03
2.	103	50·74
3.	37	42·86
4.	66	32·51
5.	61	29·9
6.	93	45·81
7.	65	32·01
8.	82	40·39
9.	73	35·96
10.	85	46·55
11.	93	45·81
12.	78	39·22
13.	61	29·9
14.	71	34·97
15.	64	31·55
16.	67	33·00
17.	98	48·27
18.	86	42·36
19.	64	31·36
20.	71	34·97
21.	97	47·78
22.	105	51·45
23.	76	37·93
24.	72	35·49
25.	91	44·8
26.	114	56·15
27.	97	47·78
28.	84	41·16
29.	111	54·38
30.	116	57·14

Thus it was found that teachers of authoritarian personality are less liked by the students (40%) and non-authoritarian (democratic) type of teachers are more liked by students (66·6%).

(B) *Analysis of Interaction Matrix*

The remaining two parts of the hypotheses were tested by applying analysis of interaction matrix of authoritarian and non-authoritarian type of teachers; which is given in Tables 5 and 6.

TABLE 5

Analyses of interaction matrix of 15 authoritarian type of teachers

S. No.	*Indirect talk (I) (1 to 4)*	*Direct talk (D) (5 to 7)*	*Total students participation (8, 9)*	*Total Silence (10)*	*Total*
1.	94	160	95	22	371
2.	68	271	97	8	444
3.	74	153	156	64	447
4.	84	175	400	82	741
5.	148	609	137	74	968
6.	112	541	159	203	1,015
7.	191	655	120	93	1,059
8.	115	454	163	329	1,061
9.	188	615	170	147	1,120
10.	70	878	110	67	1,125
11.	101	778	67	193	1,139
12.	146	355	544	105	1,150
13.	236	749	255	253	1,493
14.	325	787	180	275	1,567
15.	299	879	360	148	1,686
Total:	2,251	8,059	3,013	2,063	15,386
Percentage of Total tallies	14·63	52·37	19·60	13·40	100·00

1. (i) In our study of authoritarian type of teachers the percentages of direct teacher talk and indirect teacher talk were found to be 21·84% and 78·16% respectively, which indicates that the authoritarian type of teachers are dominative in the classroom (as their direct talk is more than 75%).
   (ii) Student participation came out to be 19·60% which is below 20% of the total interaction matrix. It indicates that students participation in classroom interaction is restricted and students feel less free in expressing their difficulties to such type of teachers.

TABLE 6

Analyses of classroom interaction of 15 non-authoritarian type of teachers

S. No.	*Total Indirect Teacher Talk (I)*	*Total Direct Teacher Talk (D)*	*Students' Talk (D8, 9)*	*Silence or confusion (10)*	*Total*
1.	18	90	36	15	159
2.	43	64	57	14	178
3.	42	144	31	5	222
4.	62	90	48	38	238
5.	57	176	80	24	337
6.	12	169	197	2	380
7.	80	118	136	79	413
8.	86	249	99	62	496
9.	186	292	205	38	721
10.	85	449	155	103	792
11.	208	668	266	82	1,224
12.	141	630	464	153	1,388
13.	319	1,041	204	57	1,521
14.	379	663	465	103	1,610
15.	269	753	292	306	1,620
Total:	1,887	5,596	2,735	1,081	11,299
Percentage	16·70	49·52	24·20	9·58	100·00

II. (i) In case of non-authoritarian type of teachers the percentages of total indirect teacher talk and direct talk were found to be 25 22% and 74·28% respectively. 25·22% (more than 25%) of indirect talk by a teacher is a good indicator of promoting integrative pattern in the classroom. Hence these statistical analyses prove that non-authoritarian type of teachers are integrative in the classroom.

(ii) Student talk came out to be 24·20% (above than 20%) which proves that students feel more free in expressing their difficulties to non-authoritarian type of teachers.

(C) *Correlation between I/D (Indirect teacher talk/Direct Teacher talk) ratio and Democratic Personality Scores*

The coefficient of correlation (r) between I/D Scores obtained from observation of classes of non-authoritarian teachers given in Table 7 and democratic personality scores (Scores obtained by reverse scoring method in F-Scale administered to teachers) was found to be + 0·34.

TABLE 7

Observation of classes of non-authoritarian Teachers

S. No.	*I/D*				*I/D 8, 9*			
	Observations				*Observations*			
	1st	*2nd*	*3rd*	*Average*	*1st*	*2nd*	*3rd*	*Average*
1.	0·11	0·12	0·46	0·23	1·49	1·42	0·90	1·27
2.	0·37	0·31	0·21	0·30	0·96	0·79	0·50	0·75
3.	0·32	0·46	0·34	0·37	1·15	0·82	0·73	0·90
4.	0·07	..	..	0·07	0·06	..	..	0·06
5.	0·41	0·58	0·67	0·55	0·56	0·65	1·25	0·82
6.	0·21	0·44	0·19	0·28	0·28	0·14	0·59	0·34
7.	0·29	0·14	0·16	0·20	0·60	0·41	0·62	0·48
8.	0·43	0·72	0·74	0·63	1·22	1·03	0·84	1·03
9.	0·15	0·20	0·25	0·20	0·43	0·50	0·57	0·50
10.	0·23	0·29	0·35	0·29	1·55	1·35	1·15	1·35
11.	0·64	0·67	0·70	0·67	0·86	0·75	0·64	0·75
12.	0·62	0·67	0·72	0·67	0·66	0·58	0·50	0·58
13.	0·30	0·33	0·36	0·33	0·77	0·71	0·65	0·71
14.	0·68	..	..	0·68	1·29	..	..	1·29
15.	0·34	..	..	0·34	0·86	..	..	0·86
	Average I/D=0·39.				*Average I/D* 8, 9=0·77			

MAIN FINDINGS

1. (*a*) The categories devised by Flanders are quite effective in Indian Schools.
   (*b*) In this study the maximum and minimum I/D ratio was found to be 0 74 and 0·04 in the English and Drawing classes respectively of Standard VIII; while at Minnesota (U.S.A.) in the Social Studies Class of VIII grade, the highest I/D ratio was found to be 0 73 and the lowest I/D ratio was 0·21 in 1956. This shows that in both the countries, the more indirect teacher influence patterns occur in the higher scoring classrooms, which is shown by the higher ratios.
   (*c*) The minimum I/D ratio (0 04) in Indian condition is too low when compared to that in the U.S.A. (0 21). This shows that Indian teachers use more direct influence patterns in classroom while American teachers use less direct influence.
   (*d*) Here the student participation comes out to be 21·90% and this is nearly consistent with the " rule of three fourths ".
2. (*a*) Teachers of authoritarian personality are less liked by the students.
   (*b*) Teachers of non-authoritarian personality are more liked by the students.
3. (*a*) Teachers of authoritarian personality tend to be more dominative in the classroom than those of non-authoritarian teachers.
   (*b*) Teachers of non-authoritarian personality are more integrative than those of authoritarian type of teachers.
4. (*a*) Students feel less free in expressing their difficulties to authoritarian type of teachers.
   (*b*) Students feel more free in expressing their difficulties to non-authoritarian type of teachers.
5. The coefficient of correlation (r) between personality scores of non-authoritarian teachers and their average I/D ratio came out to be +0·34.

INTERPRETATION

These findings should have some value for moulding teacher behaviour so as to promote better classroom climate for effective learning situations.

The significance of this study lies not only in giving us detailed information regarding classroom interaction but also in suggesting to teachers to understand their behaviour for promoting better classroom climate conditions and for creating such situations in which optimum rapport from the students can be had.

SOME SUGGESTIONS ABOUT HELPING A TEACHER CHANGE HIS BEHAVIOUR

Firstly, no single pattern of teaching can be recommended for a teacher. Each teacher must discover his own teaching style, an overall balance between indirect and direct influence. He should also discover the suitable behaviour patterns which are most suitable to different learning situations.

Secondly, only a teacher can change his own behaviour. The interaction studies can merely offer suggestions which are to be implimented by himself.

Thirdly, teacher participation should come from one's own self, it should not be forced.

Fourthly, teachers should eliminate fear of professional or administrative evaluation or both so that they may feel more free to know their own behaviour and different patterns of teaching.

Fifthly, a teacher must try to change his behaviour before it is too late. For this the change must be self-directed.

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Perception of Sexually Symbolic Concepts by Indian Adolescents

A. C. Pachaury

Masculinity-femininity ratings via the Semantic Differential of various animals, objects, parts of the body, and personal effects, were made by 85 male and 85 female college students. Psychoanalytic considerations that certain concepts symbolize masculinity or femininity have received some support in this study, though objects such as 'ship', 'Oven' and 'Room', which Freud believed symbolized femininity were rated masculine. Similarly, 'Umbrella', 'Necktie', 'Hat', and 'Foot', often considered masculine, were rated feminine. Further research seems necessary prior to accepting as accurate the sexual symbolism as outlined in the psychoanalytic literature.

Psychoanalytic literature has puzzled psychologists and lay-public since the publication of Freud's monumental work on dreams (Freud, 1952) as to the symbolic content and behaviour exhibited in projective techniques. Phillips and Smith (1953) are of the opinion that certain Rorschach content may be considered to have masculine and feminine meanings, while Gill (1967), stresses that different animals convey symbolic meaning of masculinity and femininity. The butterfly, for example, is most often perceived as feminine, and the dog as masculine. Mullen (1968) investigated how many Jungian and Freudian sexually symbolic words were given the same masculine or feminine gender in the Spanish, German and French languages. He reported that "universality of Jungian and Freudian sexual symbols in terms of their power to predict gender nouns is lacking" (p. 1041). Haley, Draguns and Phillips (1967) emphasized the lack of research evidence on sexual symbolic meaning of content responses to the Rorschach. They also remarked

that the Semantic Differential (Osgood, Suci and Tannenbaum, 1957) was seldom used to explore this field, despite being a useful technique in conducting such a research.

Worthy and Craddick (1968) used the Semantic Differential technique to investigate the masculinity-femininity of common animals, objects and parts of the body. Their findings are: " Objects such as ' Ship ', ' Oven ', and ' Room ', which Freud believed symbolized femininity were masculine. Similarly ' Umbrella ', ' Necktie ', and ' Hat ' often considered masculine were rated feminine " (p. 78-80).

Purpose

The present study was aimed at finding how Indian undergraduates perceive the masculinity-femininity contiuum of several objects, animals, parts of body and personal effects.

Method

Each of the 18 stimuli concepts presumed to symbolize masculinity or femininity was rated on a Sementic Differential form on eaoh of six scales (hard-soft; small-large; delicate-rugged; masculine-feminine, heavy-light; weak-strong) all of which have high loadings on the potency (masculine-feminine) factor forms by Osgood, Suci and Tannenbaum (1957). Each concept had a possible range of potency score from 6 (feminine) to 42 (masculine) with a possible neutral rating of 24.

Subjects

85 male and 85 female undergraduates of Arts, Science and Commerce departments of Regional College of Education, Mysore formed the sample of this study. The mean age was 21 years 8 months.

Results

The potency score for each concept is indicated in Table 1. A glance at it reveals that ' Ship ', which Freud suggested as a feminine symbol, was rated in this study as the most masculine of all the investigated concepts, and it is in direct opposition to our common reference to a ship as ' she '. Two other reversals of theoretical sexual symbolism found in this study were, ' Oven ' and ' Room ' (both considered feminine from the psychoanalytic view point). Conversely such concepts as ' Umbrella ', ' Necktie ', and ' Hat ', and ' Foot ' are commonly given masculine symbolic meaning in psychoanalytic literature were rated

TABLE 1

Potency Scores for Each Stimuli from Most to Least Potent (N=170)

Stimulus	*Mean Potency Score*†	*Sd.*
Ship*	32.911	5.51
Plough	31'505	4'91
Wolf	29'400	4'75
Dagger	29'129	5'51
Ape	28'235	6'15
Eagle	27'070	5'59
Room*	26'470	5'00
Oven*	25'617	5'05
Foot	22'768	5'24
Sheep*	21'767	5'17
Umbrella	21'223	4'53
Pocket*	20'188	5'49
Purse*	19'941	5'95
Hat	19'529	4'84
Necktie	18'881	4'75
Ear*	18'017	4'47
Chicken*	16'147	6'02
Butterfly*	12'994	5'37

*Indicates those stimuli which are theoretically feminine; all others are theoretically masculine.

†Mean potency score over 24.00 indicate masculinity; scores below 24.00 indicate femininity.

feminine in this study. Animals fared better consistently of sexual symbolic meaning attributed in the literature, with all animals rated in the predicted sexual direction. Concepts such as ' Plough ', ' Dagger ', are rated masculine and ' Pocket ', and ' Ear ' as feminine as theorized.

Discussion

The results of this study, do not support the psychoanalytic theory regarding sexual symbolism (masculine or feminine) of certain concepts. However, such concepts as ' Ship ', ' Oven ', ' Room ' are not supported as feminine sexual symbols. Perhaps the criterion of ' holdingness ', ' spaciousness ', and ' cavernous ' generally given feminine symbolic meaning, are untenable.

Other concepts requiring further investigation of their sexual symbolic meanings are those generally given masculine meaning,

perhaps in view of their shape, for example, 'Umbrella', 'Necktie', 'Hat' and 'Foot'.

In summary, the results of this study support findings of Worthy and Craddick (1969), and adds another reversal 'Foot' which is rated feminine in this study (considered male theoretically).

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A Study of Creativity in Relation to Intelligence, Extraversion and Neuroticism

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The authors attempt to find out, in the study, the relationship between creativity and such variables as Intelligence, Extraversion and Neuroticism; and the differences attributable to sex on these variables.

The last two decades have witnessed substantial work on creativity in relation to various variables; yet much remains to be answered in terms of relating the concept of Intelligence as 'convergent thinking' (Guilford, 1950,) extraversion and neuroticism as two dimensions of personality (Eysenck, 1947, 1953, 1957) to creativity. In India, relatively limited work has been done in this field; and the present study, aimed as a stop-gap attempt, was carried to find out:

(1) The relationship between:
   (*a*) Creativity and Intelligence,
   (*b*) Creativity and Extraversion,
   (*c*) Creativity and Neuroticism,
   (*d*) Intelligence and Extraversion,
   (*e*) Intelligence and Neuroticism.

(2) The differences between the high-creative group and low-creative group with regard to their intelligence, extraversion and neuroticism.

(3) The differences attributable to sex on the above variables.

Delimitation of Key Concepts

In view of the various explanations advanced for each of the four variables dealt with in the present study, it was considered essential by the investigators to restrict and delimit the variables in terms of the

following definitions:

(*a*) *Creativity* considered (as advocated by Kneller: 1966) in terms of products, *viz.*, subjects' products in language on a particular theme.

(*b*) *Intelligence*, synonymous with 'convergent thinking' (Guilford, 1950), as the capacity to carry on abstract thinking through embodying different principles of classification, order-sequence and non-verbal analogy—as viewed against an expected culture-free background.

(*c*) *Extraversion and Neuroticism:* based on Eysenck's theory of personality (Eysenck, 1947, 1953, 1957). As such, Neuroticism is only a level of emotionality, the emotional over-responsiveness and liability to break down under stress. Autonomous Nervous system (ANS) is the seat of Neuroticism.

On the other hand, Extraversion is the quality related to conditionability and deconditionability of the central nervous system (CNS); the physiological basis of extraversion evidently being in the CNS.

Procedure

The following tools were used to measure the variables undertaken in this study:

(1) Jenkin's Non-Verbal Group Test of Intelligence Standardized by CIE to measure intelligence.

(2) MPI adapted on India Population by Dutt (1967) to measure extraversion and neuroticism.

(3) A Verbal Test on a Verbal Stimulus to measure Creativity; the stimulus being the theme 'The dream I can never forget,' later scored independently by a panel of five judges in terms of (i) imagery, (ii) originality, (iii) sensitivity, (iv) flexibility and (v) consciousness; the score of the subject being the mean of the pooled scores awarded by the panel of judges.

The study was conducted on 200 subjects (X class students: boys=100, girls=100) randomly selected from Delhi Schools. The selection of X class students as the subjects for this study was influenced by the widely agreed-upon fact that one's creative powers go hand-in-hand with one's physiological development, both reaching their apex towards late teens.

Statistical Analysis

The following tables show various statistics calculated on different groups:

TABLE 1

Statistical Analysis—Scores on Creativity, Intelligence, Extraversion and Neuroticism

Variables / *Statistics*	*Creativity*			*Intelligence*			*Extraversion*			*Neuroticism*		
	Whole group $N=200$	*Boys* $N=100$	*Girls* $N=100$	*Whole group* $N=200$	*Boys* $N=100$	*Girls* $N=100$	*Whole group* $N=200$	*Boys* $N=100$	*Girls* $N=100$	*Whole group*	*Boys*	*Girls*
Range	5·40	5·40	5·37	13·81	29·81	13·81	8·41	11·41	8·40	4·43	4·38	4·43
Mean	15·25	15·50	15·00	55·65	58·00	53·30	29 85	30·20	29·45	22 44	21·40	23·35
Mdn	13·18	13·74	12·53	57·46	59·78	55·21	30·50	31·04	29·83	22·44	21·59	23·21
Mode	9·04	10·22	7·59	61·08	63 34	59·03	31·80	32·72	30·59	22·44	21·97	22·92
S.D.	8·15	7·70	8·57	13·46	11·86	14 51	6·14	5·89	6·26	8·14	8·30	7·85
Ku	0·238	0·247	0 186	0·258	0·224	0·264	0·255	0·252	0·257	0·255	0·258	0·259
SK	0 762	0 686	0·865	0 403	0 449	—0·039	—0·317	—0 428	—0·183	0·002	—0 067	0·016

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

TABLE 2

Correlation (Pearsonian) between Creativity, Intelligence, Extraversion and Neuroticism

	Creativity	*Intelligence*	*Extraversion*	*Neuroticism*
Creativity	..	0·28	0·08	0·13
Intelligence	0·28	..	0·11	−0·16
Extraversion	0·08	0·11	..	−0·11
Neuroticism	0·13	−0·16	−0·11	..

TABLE 3

Significance of differences between means of Boys and Girls on Creativity, Intelligence, Extraversion and Neuroticism

	Mean		*S.E.*	*C.R.*	*Level of significance*
	Boys	*Girls*			
Creativity	15·50	15·50	1·15	0·432	Not significant
Intelligence	58·00	53·30	1·86	2·496	"
Extraversion	30·20	29 45	0·86	0·869	"
Neuroticism	21·40	23·35	1·14	1·698	"

TABLE 4

Significance of differences between means of High-Creative and Low-Creative Subjects

	M an		*S.E.*	*C.R.*
	High Creative (N=21)	*Low Creative (N=21)*		
Intelligence	61·14	59·19	3·80	2·612*
Extraversion	31·86	31·05	2·10	0·385
Neuroticism	24·05	21·33	3·38	1·140

*denotes significance at 0·02 level.

Findings

The findings of this study, in main, are:

(1) The four variables, *viz.*, Creativity, Intelligence, Extraversion and Neuroticism are almost normally distributed. However, some of the peculiarities noted are:

(*a*) The distribution of the scores on creativity is positively skewed revealing, thus, a general lack of creativity in the population. Even though the pupils coming from this population bag very high percentage of scholarships in the National Science Talent Programme, the possible explanation could be the different nature of scientific creativity from verbal creativity.

(*b*) Distribution of Intelligence among the boys is positively skewed while for girls, it is not so.

(*c*) The distribution of Extraversion among the boys is negatively skewed, thus revealing a higher incidence of extraverts among the boys.

(2) The distribution of creativity is almost mesokurtic for the entire population as well as the boys' but in the case of the girls, it is largely leptokurtic, thereby decreasing the number of scores in the vicinity of the mean.

(3) The distributions are spread between ± 4 S.D. and ± 5 S.D., thus revealing the absence of extreme cases. Perhaps this is because of the selective mode of admission adopted for the sample.

(4) The relationship between creativity and intelligence is curvilinear, positive and somewhat substantial. To a certain extent, creativity and intelligence go together, but thereafter, take different directions. As such, highly creative subjects need not necessarily be highly intelligent as well (Getzel & Jackson, 1958, Torrence, 1960). However, the findings of Cicirelli (1965) and Edward & Tylor (1965) are not supported by this study.

(5) The correlation between Extraversion and Creativity is zero. More and more researchers ascribe to the thinking that creativity is not a unitary trait but an amalgam of many discrete abilities and personality. The orthogonal relationship between the two variables perhaps indicates that

extraversion-introversion dimension is not a component of creativity. However, in view of paucity of research in this area, the verdict of later researches alone can prove or disprove the argument.

(6) The correlation between creativity and Neuroticism is slight though positive. Dutt (1970) found out a correlation of 0·81 between Anxiety and Neuroticism and logically; anxiety and neuroticism are practically identical. May (1950) puts forth the plea that creativity is the only way to control anxiety. Hence, theoretically we can look for a low positive correlation between anxiety (or neuroticism) and creativity.

(7) The relationship between Extraversion and Intelligence is insignificant. Eysenck (1947, 1953, 1957) has usually maintained Intelligence as a statistically independent factor of personality and Cattell (1963) also surmises that in the light of available evidence, there is little cause to doubt lack of correlation between the cognitive and the conative-affective aspects of personality. However, most researches in this area have failed to allow for the possibility of curvilinear regression, equating orthogonality with linear independence. This being true of the present study is, however, one of its limitations.

(8) The correlation between intelligence and Neuroticism is slight and negative. The argument put forth earlier supports this. It has become customary to equate neuroticism, at least in some aspects, with the concept of drive as postulated by Dollard and Miller. Taken together with the Yerkes-Dodson law, this may hint at the possibility of a curvilinear relationship between Intelligence and Neuroticism, and the present study supports this assumption.

(9) The relationship between Extraversion and Neuroticism is negative, though very low ($r = -0{\cdot}11$) This is confirmed by Dutt (1967), Bendig (1959), Jalota (1964) and De (n.d.). This consistency of negative correlation between these two variables perhaps reveals the proneness of Introverts to neurotic tendencies.

(10) The differences between the two sexes on these variables are not significant (Dutt, 1967, Jalota, 1964).

(11) The differences between the High-Creative and the Low-Creative on Extraversion and Neuroticism are not significant. However, the differences on Intelligence are significant (at 0·02 level).

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On Teacher-Pupil Relationship*
—A Social-Psychological Point of View

Biswanath Roy

The author attempts to analyse the teacher—pupil relationship in the context of important psychological studies conducted so far. He pleads that since the teacher is the leader in the classroom, he needs greater attention of social psychologists to help him in behaviour modification.

The subject of teacher-pupil relationship has always been evoking stimulating discussion. What should be the exact or near to exact character of this relationship has been speculated from time to time. But the character of relationship has been more or less ideological and subjective than pragmatic and objective, and as such it could not stand the test of temporal, spatial and individual modalities. In short, conventions became only relatively true, instead of entering into any situational analysis. The present-day calamities in this relationship tend to strengthen the above observation. In fact, the value system around this relationship has changed or has taken different, if not opposite shapes, in accordance with the tremendous increase in the student population, radical changes in the patterns and policies of the educating institutions, the growth of scientific and technological ventures, breaking some of the age old concepts and the facelifting of the Indian system by incorporating the Table-Chair-Black Board-Bench-Desk system of the West. In all, the process and the aspects of rapid social change, specially with reference to India as a developing country, may be held responsible for it.

*Paper read in the All India Seminar on 'Behaviour Modification in School Setting', held in the NIE Campus between 28-1-71 to 4-2-71.

But the tendency has so far been to blame the students. But modern educational research, particularly research during the last decade, has demonstrated the importance of teacher behaviour in the class and its impact upon building a conducive teacher-pupil relationship. What goes on in the class determine the product at the end. We have, so far, paid little or no pragmatic attention to the process of work in the class.

The contention of this paper, is to focus and illustrate the following:

1. Theoretical models of human behaviour and their movements.
2. Identification of some more important extra and intra-classroom beha iour of the teacher.
3. Introducing a technique to incorporate these more important behaviour in the teacher.

Each of the above mentioned aspect will be treated separately.

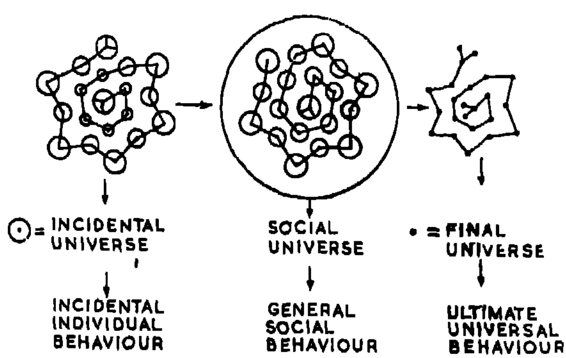
Theoretical Models of Human Behaviour and Their Movements

Studying, predicting and modifying human behaviour is a challenging job, a compl cated one too. Sometimes some people prefer to say: 'I am too old a dog to learn new tricks'—a favourite proverb among persons growing in age and experience. They refuse to entertain new concepts and philosophies developing around the question 'how to live better?' Psychoanalysts have labelled these people as cases of 'character-formation'. Once a character gets formed, it becomes a way of living for the person from which he may deviate only under extreme circumstances. It has been observed that the behaviour of these people becomes more predictive and easy to study but extremely difficult to modify. They develop very specific and particular types of social role playing. Since they happen to be in into the very much obsessed social systems, their mental open-endedness, succeptibility and vulnerability for the adoption and practicing the basic realities in life come down to an almost relative end point. To them experiencing the varieties of life becomes a closed affair. The process of social change and constant urbanization has led to this sort of character-formation. The persons themselves or emerging social structure (which supposedly becomes further affluent, good, permissive and creative) or even industrialization and urbanization can hardly be blamed for this. It is due to the faulty behavioural pattern setting efforts, the ways of social-psychological upbringing of the person as a whole. It is completely forgotten that he is a dynamic unity, a whole person, and cannot be treated part by

part at any time. In the light of this, it is worth studying the behaviour structure of the person through the following model:

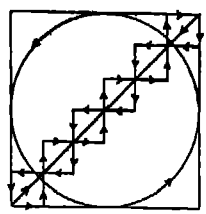
1. Incidental individual behaviour.
2. General social behaviour.
3. Ultimate universal behaviour.

If behaviour is a function of the interactions between the person and his environment, then first, we have to isolate the individual on the one hand and his social roles on the other. Psycho-physical analysis of the individual growth patterns are available by virtue of the researches in this area. But we are yet to isolate the various social roles, with which a person interacts in his day to day life. For example right from the moment he leaves the bed in the morning till he goes to bed again at night (we need not consider the sleeping phase just to avoid further complications), the individual performs scores of activities fulfilling his social roles. It may be the washing and cleaning of the mouth, doing exercise, taking hot cup of tea, reading newspaper, shaving, bathing, going to the place of work or study, interactions with the professors or colleagues, solving different problems, observing lunch time, tea-time, etc., etc. These are incidental individual behaviours coming out of incidental universe. Next is general social behaviour, Diagrammatically:

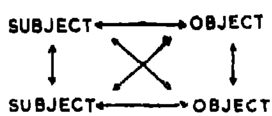


The social universe embodies individual behaviour to make it general social behaviour. The ultimate universal behaviour only shows the set patterns of expressions of the final universe. The connections show the outward and inward movements. The incidental and social circles get dissolved in the ulterior one. As a matter of precaution, it may be pointed out here that neither the incidental individual behaviour,

nor the general social behaviour and the ultimate universal behaviour patterns are discrete or independent units of programmes but they are simultaneously and successively incoming and out going processes. The process is either gradual or sudden in a linear-circular or horizontal-vertical axis of movement. Diagrammatically:



Again the simultaneously and successi.ely incoming and outgoing performance is but a continuous interaction between the subjective and the objective roles, that is, between the individual and his social roles. It may follow the following patterns:



In the light of the above we enter into the specific problem of some intra and extra-classroom behaviour situations, faced by the teacher.

(C) *Identification of some more Important Intra and Extra-Classroom Behaviours of the Teachers*

How the teacher behaves in the classroom, in addition to what is being taught and how it is taught, is more important in the sense that, it sets the pattern of pupil behaviour, giving rise to a certain kind of teacher-pupil interaction. We know from our experience that some teachers are more friendly than others towards their pupils. They eagerly and patiently hear what their pupils have to say; they try to answer their questions and satisfy their doubts. They try to accept students' ideas and expand them, thus encouraging them to think independently. On the other hand, there are teachers who tend to discourage questions and rebuke the pupils. They have a habit to enforce their own views and authority, thus discouraging independent thinking. It is the general behaviour which is important.

The teacher behaviour as stated above, sets the pattern of the classroom behaviour. If, for example, the teacher is dominative pupils may exhibit fear behaviour. They may suppress their feelings and be tense. This also depends upon the kind of task and amount of clarity of the goals to be achieved. That teacher can prove effective who is aware of his goals or knows what he wants to achieve. All these create a classroom climate which may effect classroom learning as well as socio-emotional development of the students.

By extending the thinking a Gage, Runkel and Chatterjee (3) the present author found out the following twenty behaviours to be more important in the classroom settings. The list was developed in connection with a research project entitled 'Changing Teacher Behaviour Through Feedback'. The twenty behaviours were:

1. Enjoys funny remarks made by pupils.
2. Praises what pupils say in class discussion.
3. Tells pupils about some interesting things to read.
4. Influencing pupils toward his her own orientation.
5. Suggests to pupils new and helpful ways of studying.
6. Talks with pupils after school about ideas the pupils had.
7. Asks small groups of pupils to study something together.
8. Shows pupils how to look up an answer when the pupils can't find it themselves.
9. Asks the pupils what they would like to study in tomorrow's lesson.
10. Acts disappointed when pupils get something wrong.
11. Asks the class what they think of something a pupil has said.
12. Modifying his or her attraction toward the pupils, *i.e.*, liking them less.
13. Supports the lesson with examples from day to day life.
14. Cordially welcomes any new comer to the class.
15. Cares friendship among all the students.
16. Behaves equally with every student.
17. Takes up seriously and does everything possible to restore the efficiency of the students.
18. Insists upon the completion of the home tasks.
19. Keeps in touch with the progressive literature, not only in the subject of specialization but on others as well.
20. Helps the pupils to go up by themselves.

Technique to Incorporate These Behaviours

The technique concerned should be highly effective in reinforcing any of the more important behaviour patterns which might be missing in the teachers' total behaviour in the classroom. Reinforcement from the learning point of view will induce the changes or modifications in the behavioural lacuna of the teacher. The induction of the changes or modifications may either be an incoming or an outgoing process through either positive or negative feedback systems.

Flanders (2), Smith (7) and many others have made several attempts to analyse the teacher-pupil interaction in the classroom behaviour by the teacher. In India very lately some studies have just been started. The Indian studies are using the Flander's system more intensively and extensively than any other. This paper also recommends this technique.

Ned A. Flanders has developed a system of observation and recording class-room verbal interaction. The system contains ten categories based upon direct-indirect teacher influence, teacher-student talk and confusion or silence. This ten-category system was used to produce a feedback to the teacher, about his behaviour in the classroom.

It will be attempted now to show and fix the 20 behaviours to the various categories of this system.

TABLE 1

Categorized Behaviours of the Teacher

Categories	*Behaviours*
1.	1, 8, 9, 16, 20
2.	2, 3, 5, 8, 14, 15, 16, 20
3.	3, 5, 6, 8, 11, 13, 19, 20
4.	9
5.	X
6.	3, 4, 5, 7, 15, 17, 18
7.	4, 10, 12, 17
8.	1, 2
9.	1, 2
10.	X

Table 1 indicates that the twenty behaviours are related to the categories 1, 2, 3, *i.e.*, better parts of the indirect influence by the teacher and categories 6 and 7, *i.e.*, direct influence by the teacher. There had been little or no emphasis for the categories 4, 5 and 10 which are for asking questions, lecturing and confusion or silence. Flander's system attempts to find out the overall picture of the teacher-pupil interaction in three directions. They are: percentage of time devoted for lecturing, the teacher-student ratio and the indirect-direct ratio. Higher percentage of lecturing, higher TS ratio and lower ID ratio serve as indicators, contrary to the propositions that the teacher should be lecturing less, exert himself less and be more indirect in the classroom discourse. Some more findings may be had from another paper by the author on ' Teacher Behaviour Patterns in Teaching Various Materials '.

The interaction analysis is helpful in that:

(i) After observing the classroom discourse, the percentage of lecturing, TS and ID ratios are found out. Lecturing to the extent of 40% and above, and similar TS and ID ratios are considered as input materials for feedback.

(ii) Generalized suggestions, like, attempting to decrease the high percentage of lecturing and TS ratio or increasing the ID ratio may not be easily comprehended by the teacher. To give these specific meanings, the teacher concerned may be advised to modify or change his behaviour. Here the behaviour items become helpful.

(iii) Since all the 20 behaviours are equally important, therefore, the band was spread to keep all the possibilities open. As yet studies have not been conducted to determine these limits. This can be attempted in the form of adjoining research.

The two earlier studies by the author (5, 6) revealed that: (1) the preferable qualities of the teaches are: Adjustible, Reasonable, Sound Academy, Energetic, Assertice, etc., (2) Educational affairs are the foremost factors of unrest among the students. These findings, all the more suggest that the studies of teacher behaviour and teacher-pupil interactions in the classroom are the major sources for supplying data for the improvement of teacher pupils relationship.

General Remarks

When a social psychologist speaks of changing human behaviour or modify it from one pattern to the other, may not do justice if he

stresses the economic conditions too much. Like a radical humanist he believes that people are by and large rational. Also, the social psychologist's emphasis is upon the minimum natural expectations of the functional professional environment of the individual. It would be an attempt to:

1. Determine the cause-effect relationship of the perception of the individual.
2. Change the perceptions of the individual.
3. Persuade him for achieving excellence.

The above may be useful for changing or modifying human behaviour in certain directions for certain requirements as per the demands of the time, place and person. For the first requirement it was observed in another experiment done by the author (4) that the effects of needs, moods, wishes, demands (the phenomenological factors of perception) results in (*a*) Overestimation of things when the need, etc., are intense and (*b*) Underestimation of the things when the need is not intense. Although this was a follow-up study of another study done by Bruner and Goodman (1), it gives an idea about the things that may come up to establish the cause-effect relationship in human behaviour.

The second step is all the more important because it banks upon a very crucial question: 'Can human behaviour be changed?' The answer to this question depends upon two things: (1) An understanding of the human behaviour in general, (2) The direction of the change. Both of these two things have been analysed earlier through models. Along with the other observations, it can be concluded that human behaviour can be changed or modified, meaning significant changes in the autochthonous perceptions, by putting the individual in a problem situation, by heightening his ego involvements, believing in his rationality and compounding abilities.

There is no substitute for a good teacher. Teachers in our schools may be lacking adequate subject-matter knowledge but in terms of the potentialities, they may not fall back. Considering the teacher as an individual, twenty important ultimate universal classroom behaviours have been isolated for him. These are parts of the bigger general social behaviour and belong to the numerous incidental behaviours. The movements have also been isolated only in the direction of improving the minimum natural expectations of his professional requirements, and specifically in the direction of improving his relationships with the students. The method suggested earlier can also be of some use.

One may wonder, however, whether it is wholly the responsibility of the teacher or whether the students also have some role to play in making the relationship a happy one. It must be considered as a shared responsibility of both—one being the giver and the other receiver. The givers responsibility is much more than the receiver's, since he is to take care of the things that is being given and given in an acceptable manner. If there be anything wrong in these two, the receiver may receive the given material and the giver, only in a half hearted manner. Since the teacher is the leader in the classroom, he has a more crucial role to play. He remits the rewards and punishments and thus sets and maintains the climate which either can facilitate or hinder growth-oriented activities. Therefore, for any change or development of the relationship we have to study and help the teacher more and more.

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Stabilization of Abilities during Adolescence—II

(A Cross-Sectional Study)

*Atmananda Sharma**

This is the second part of the report of a study conducted on 2628 Delhi school children from 5 schools, reading in classes eight, nine, ten and eleven belonging to all courses, humanities, science and commerce, representing a wide range of parental occupations and socio-economic levels. Tests of verbal deductive reasoning, numerical ability, spatial clerical speed and accuracy and mechanical ability were administered. The growth curves or better age progress curves for the six abilities showed different characteristics. In the first two, there was similarity with brighter groups starting at a higher level but growing at a slower rate. The growth curves for numerical, clerical and mechanical had almost similar characteristics. Rates of growth of pupils of different degrees of brightness was almost equal and, therefore, the differences observed in the beginning at the eighth grade were maintained throughout the three-year period. The growth curves of spatial ability indicated that brighter groups not only began at a higher level but grew at a faster rate so that the differences between brightest and dullest had increased by eleventh grade. Indications given by the growth curve for the modal age group are slightly different.

*The author was assisted by Shrimati Shakuntala Bhatia, M. S. Savita and P. C. Bansal in the collection and scoring of the data. K. P. Garg was mainly responsible for the analysis of the data. Shib K. Mitra, Perin H. Mehta, Harold Webster and the members of the departmental committee offered advice and comments.

V. Independence of Abilities

All scientists are aware that nothing can be measured with precision. The differences discovered with the help of psychological tests or a battery of aptitude tests depend upon (*a*) the extent to which the individuals differ within themselves and (*b*) upon the reliability of the tests. Before examining the disparity among abilities it will be worthwhile to see the reliabilities of tests for different age-cum-grade groups.

Test Reliability

Test reliability for the different age cum grade groups was worked out by using the following Kuder Richardson formula:

$$r_{tt}=\frac{n\,\sigma_t^2-M\,(n-M)}{(n-1)\,\sigma_t^2}$$

where r_{tt}=reliability of the test

n=number of items in the test

M=mean of test scores

σt=standard deviation of test scores.

It is well-known that this formula under usual testing conditions gives a lower-bound estimate of r_{tt}.

Verbal Ability

The reliability co-efficients for verbal ability test for the various grade cum age groups are shown in Table 35.

TABLE 35

Reliability Coefficients for Verbal Ability Test

Class	*Age*	*12+*	*13+*	*14+*	*15+*	*16+*	*17+*	*18+*	*19+*	*Whole Group*
VIII	r_{tt}	·90	·93	·89	·91	·86				·92
	N	(88)	(199)	(123)	(96)	(15)				(521)
IX	r_{tt}	..	·91	·92	·80	·89	·87			·90
	N		(69)	(190)	(119)	(77)	(44)			(499)
X	r_{tt}	..	..	·89	·89	·84	·86	·75		·87
	N			(59)	(108)	(102)	(58)	(30)		(357)
XI	r_{tt}	..	..	..	·90	·83	·92	·85	·87	·88
	N				(31)	(96)	(75)	(53)	(28)	(283)

The reliability co-efficients range between ·75 and ·93. Is the test sufficiently reliable for drawing accurate conclusions ? Thorndike and Hagen (1960) worked out the probabilities for reversal of direction in differences for scores falling at 75th and 50th percentiles for tests of differing reliabilities, it is reproduced in Table 36. Percent of Times Direction of Difference will be reversed in Subsequent Testing for Scores Falling at 75th and 50th percentiles.

TABLE 36

Reliability Co-efficient	*Means of Groups of 25*	*Means of Groups of 100*
·00	50·0	50·0
·40	10·9	0·7
·50	4·6	0·04
·60	1·2	
·70	0·1	
·80		
·90		
·95		
·98		

Thus it is seen that a test with relatively low reliability can be used to make useful studies and to draw accurate conclusions about groups. For small groups reliability of ·60 and for large groups a reliability of ·50 is sufficient to draw certain kinds of conclusions. Further this is all the more true in the present study as the reliabilities have been calculated for homogeneous groups—students of the same age and grade, and also because the formula used is one which gives a lower bound estimate of the reliability of a test.

Reasoning Ability

The reliability co-efficients for reasoning ability test for the various grade cum age groups are shown in Table 37.

TABLE 37

Reliability Co-efficients for Reasoning Ability Test

Class	*Age*	*12+*	*13+*	*14+*	*15+*	*16+*	*17+*	*18+*	*19+*	*Whole Group*
VIII	r_{tt}	·80	·85	·82	·77	·74				·84
	N	(88)	(199)	(123)	(96)	(15)				(521)
IX	r_{tt}	.	·67	·83	·82	·79	·75			·84
	N		(69)	(190)	(119)	(77)	(44)			(499)
X	r_{tt}	..	..	·63	·73	·79	·82	·79		·78
	N			(59)	(108)	(102)	(58)	(30)		(357)
XI	r_{tt}	..	..	..	·78	·61	·80	·85	·82	·79
	N				(31)	(96)	(75)	(53)	(28)	(283)

From the above table it is seen that the reliability co-efficients range between ·62 and ·85. They are quite high for drawing accurate conclusions about groups, for the reasons discussed earlier.

Numerical Ability

The reliability co-efficients for numerical ability test for the various grade cum age groups are shown in table 38.

TABLE 38

Reliability Co-efficients for Numerical Ability Test

Class	*Age*	*12+*	*13+*	*14+*	*15+*	*16+*	*17+*	*18+*	*19+*	*Whole Group*
VIII	r_{tt}	·78	·81	·79	·71	·69				·81
	N	(88)	(199)	(123)	(96)	(15)				(521)
IX	r_{tt}	..	·85	·93	·80	·79	·78			·85
	N		(69)	(190)	(119)	(77)	(44)			(499)
X	r_{tt}	..	..	·85	·89	·89	·84	·99		·89
	N			(59)	(108)	(102)	(58)	(30)		(357)
XI	r_{tt}	..	..	..	·81	·88	·91	·90	·95	·89
	N				(31)	(96)	(75)	(53)	(28)	(283)

The reliability co-efficients for the numerical ability test vary between ·68 and ·99 and are quite high for drawing conclusions about groups as discussed earlier.

Spatial Ability

The reliability co-efficients for spatial ability test for the different grade cum age groups are shown in Table 39.

TABLE 39

Reliability Co-efficients for Spatial Ability Test

Class	*Age*	*12+*	*13+*	*14+*	*15+*	*16+*	*17+*	*18+*	*19+*	*Whole Group*
VIII	r_{tt}	·89	·92	·90	·88	·91				·91
	N	(88)	(199)	(123)	(96)	(15)				(521)
IX	r_{tt}	..	·90	·81	·91	·85	·84			·91
	N		(69)	(190)	(119)	(77)	(44)			(499)
X	r_{tt}	..	..	·90	·92	·93	·91	·94		·93
	N			(59)	(108)	(102)	(58)	(30)		(357)
XI	r_{tt}	..	..	..	·95	·92	·90	·92	·94	·92
	N				(31)	(96)	(75)	(53)	(28)	(283)

The reliability co-efficients of the spatial ability test range between ·81 and ·95 and are, therefore, very satisfactory for drawing conclusions about groups.

Clerical Ability Test

The reliability co-efficients for the different grade cum age groups for the clerical ability test are shown in Table 40.

TABLE 40

Reliability Co-efficients for Clerical Ability Test

Class	*Age*	*12+*	*13+*	*14+*	*15+*	*16+*	*17+*	*18+*	*19+*	*Whole Group*
VIII	r_{tt}	·85	·89	·79	·89	·85				·87
	N	(88)	(199)	(123)	(96)	(15)				(521)
IX	r_{tt}	..	·91	·92	·92	·91	·66			·91
	N		(69)	(190)	(119)	(77)	(44)			(499)
X	r_{tt}	..	..	·93	·92	·90	·91	·87		·91
	N			(59)	(108)	(102)	(58)	(30)		(357)
XI	r_{tt}	..	..	..	·95	·92	·90	·92	·94	·93
	N				(31)	(96)	(75)	(53)	(28)	(283)

Excepting two groups—class VIII/14+ and class IX/17+ for which the reliability co-efficients are .79 and .66 respectively—the reliability co-efficients for the clerical ability test for the other groups are very high and range between ·85 and ·95 and therefore meaningful conclusions can be drawn about groups.

Mechanical Ability

The reliability co-efficients for the mechanical ability test for different grade cum age groups are set out in Table 41.

TABLE 41

Reliability Co-efficients for Mechanical Ability Test

Class	*Age*	*12+*	*13+*	*14+*	*15+*	*16+*	*17+*	*18+*	*19+*	*Whole Group*
VIII	r_{tt}	·83	·80	·79	·75	·71				·80
	N	(88)	(199)	(123)	(96)	(15)				(521)
IX	r_{tt}	.	·85	·85	·81	·78	·85			·84
	N		(69)	(190)	(119)	(77)	(44)			(499)
X	r_{tt}	..	..	·86	·84	·86	·82	·78		·86
	N			(59)	(108)	(102)	(58)	(30)		(357)
XI	r_{tt}	..	..	..	·89	·89	·87	·89	·84	·89
	N				(31)	(96)	(75)	(53)	(28)	(283)

The reliability co-efficients of the mechanical ability test range between ·71 and ·89 and are, therefore, very satisfactory for drawing conclusions about groups.

Thus all the tests were quite reliable for making groups comparisons and for drawing conclusions.

Disparity among Abilities

A formula for appraising the degree of communality or disparity between the traits was devised by T. L. Kelley (1923). It has been described in Appendix II. The formula yields values ranging between zero and one which represent 'The proportion of differences in excess of chance proportion,' *i.e.*, differences not attributable to either the unreliability of the tests or to the overlapping measurement by them. Segel (1934) states that when the proportion of differences is 25% or more, it may be regarded as indicative of dispartity among the mental traits.

Grade Eight

Application of the formula to all possible pairs among the six ability tests produced the data of Table 42 for the five levels of brightness of class eight.

TABLE 42

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for First Level of Brightness (N=88)

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	35%	..				
N	40%	35%	..			
S	47%	39%	39%	..		
C	44%	37%	38%	44%	..	
M	40%	34%	36%	40%	40%	..

Thus it is noticed that the proportion of differences vary between 34% and 47% and exceeded the criterion value of 25 per cent for each of the 15 possible differences. It indicates that the various abilities do not develop in a parallel manner as 34% to 47% of the eighth grade children (belonging to first level of brightness) show measurable differences in abilities. It may be worth emphasising that these observations apply merely to differences in ability as revealed by the tests and not to intrinsic differences within the children.

TABLE 43

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Second Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	42%	..				
N	41%	37%	..			
S	52%	45%	41%	..		
C	50%	41%	40%	49%	..	
M	30%	36%	34%	38%	40%	..

For the second level of brightness the proportion of difference varies between 34% and 52% and observation made on Table 42 equally apply to Table 43.

TABLE 44

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Third Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	39%	..				
N	39%	35%	..			
S	46%	42%	41%	..		
C	39%	36%	34%	41	..	
M	36%	33%	33%	37%	33%	..

For the third level of brightness the proportion of differences range between 33% and 46% and observations made on Table 42 equally apply to Table 44.

TABLE 45

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fourth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	35%	..				
N	36%	28%	..			
S	50%	39%	35%	..		
C	50%	40%	36%	47%	.	
M	38%	30%	27%	36%	36%	.

For the fourth level of brightness the proportion of differences in excess of chance varies from 27% to 50% for all pairs; it is low for three pairs: 27% for numerical=mechanical, 28% for numerical=reasoning and 30% for mechanical=reasoning. But all the values exceed the criterion value of 25% and the remarks made on Table 42 also apply to Table 45.

TABLE 46

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fifth Levels of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	30%	..				
N	32%	25%	..			
S	48%	42%	40%	.		
C	45%	40%	32%	45%	..	
M	29%	29%	32%	39%	36%	..

For the fifth level of brightness the proportion of differences in excess of chance varies from 25% to 48% and as all these values exceed the criterion value of 25%, the remarks made on Table 42 still apply to Table 46.

However it may be mentioned that as we proceed from first level of brightness to fifth level of brightness the lower limit of the range of proportion of differences in excess of chance goes on decreasing. For the fifth level of brightness it is 25% for numerical-reasoning, 29% for mechanical-verbal.

Grade Nine

Application of the formula for studying disparity in ability scores to all the possible pairs among the six abilities produced the data of tables 47-51 for the five levels of brightness of class IX.

TABLE 47

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for First Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	32%	..				
N	45%	27%	..			
S	52%	33%	44%	..		
C	50%	32%	42%	50%	..	
M	44%	28%	40%	42%	45%	..

For the first level of brightness the proportion of differences in excess of chance varies from 27 % to 52 %, it is 27 % in case of one pair, numerical-reasoning. The remarks and observations made on Table 42 also apply to Table 47.

TABLE 48

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Second Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	40%	..				
N	50%	43%	..			
S	43%	37%	42%	..		
C	51%	43%	51%	42%	..	
M	44%	40%	44%	37%	44%	..

All the proportions of differences in excess of chance proportion exceed the criterion value of 25 per cent and they range between 37 % and 51 %. The observations made on Table 42 apply more and more and to data of Table 48.

TABLE 49

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Third Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	34%	..				
N	34%	36%	..			
S	42%	43%	41%	..		
C	42%	53%	40%	51%	..	
M	36%	38%	35%	41%	43%	..

For the third level of brightness the proportions of differences in excess of chance proportion range between 34 % and 51 %. Therefore the remarks made on Table 42 apply to data of Table 49 very well.

TABLE 50

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fourth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	37%	..				
N	38%	36%	..			
S	43%	37%	36%	..		
C	49%	40%	41%	45%	..	
M	39%	33%	33%	31%	42%	..

For the fourth level of brightness the proportions of differences in excess of chance proportions range between 31% and 49% and thus all of them are above the critical value of 25 per cent. The remarks made on Table 42 equally apply to the data of Table 50.

TABLE 51

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fifth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	24%	..				
N	40%	31%	..			
S	43%	36%	35%	..		
C	31%	26%	29%	34%	..	
M	45%	36%	36%	37%	32%	..

For the fifth level of brightness 14 pairs yield values above the critical value of 25 per cent while for one pair, verbal-reasoning, the proportion of difference in excess of chance proportion is 24 per cent only.

The proportion is low for two more pairs as well; it is 26% for clerical-numerical. For the remaining twelve pairs it lies between 32% and 45%.

Thus it is seen that, for class IX as well, the upper and lower limits of the proportions of differences go on decreasing as we move from first level of brightness to the fifth level of brightness.

Grade Ten

Application of the formula for studying the disparity between mental traits to all pairs among the six tests given to class X students belonging to five levels of brightness produces the data of Tables 52-56.

TABLE 52

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for First Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	28%	..				
N	43%	27%				
S	48%	30%	45%	..		
C	51%	33%	46%	52%	..	
M	44%	27%	39%	44%	49%	..

For the first level of brightness the proportions of differences in excess of chance proportions lie between 27% and 52%. Therefore the comments made on Table 42 apply to data of Table 52.

TABLE 53

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Second Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	35%	..				
N	45%	35%	..			
S	51%	39%	49%	..		
C	51%	39%	50%	53%	..	
M	43%	33%	39%	45%	46%	..

The proportions of differences in excess of chance proportion for the second level of brightness lie between 33% and 83% and therefore the remarks made on Table 42 apply here to data of Table 53.

TABLE 54

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Third Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	36%	..				
N	44%	40%	..			
S	48%	43%	50%	..		
C	45%	40%	48%	50%	..	
M	41%	39%	43%	45%	46%	..

For the third level of brightness the values of pairs range from 36% to 50% and are thus above the critical value of 25 per cent. The remarks and observations made on Table 42 apply to data of Table 54 as well.

TABLE 55

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fourth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	39%	..				
N	42%	40%	..			
S	48%	42%	45%	..		
C	47%	44%	46%	49%	..	
M	42%	38%	39%	40%	45%	..

The proportions of differences in excess of chance proportion for the fourth level of brightness lie between 39% and 49% and therefore, the remarks and observations made on Table 42 apply to data of Table 55.

TABLE 56

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fifth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	31%	..				
N	47%	47%	..			
S	43%	44%	67%	..		
C	37%	35%	53%	46%	..	
M	31%	32%	49%	41%	33%	..

The proportions of differences in excess of chance proportion lie between 31% and 53% and all are above the critical value of 25%. The remarks made on the data of Table 42 equally apply to the data of Table 56.

For all levels of brightness at the tenth grade there is no proportion which is less than the critical value.

Grade Eleven

Application of the formula for studying the disparity between mental abilities to all possible pairs among the six abilities for the eleventh grade students produced the data of Tables 57 to 61.

TABLE 57

Proportion of Differences in Excess of Chance Proportion (Expressed Percentages) for All Pairs of Abilities for First Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	37%	..				
N	44%	35%	..			
S	55%	43%	45%	..		
C	51%	41%	40%	53%	..	
M	46%	39%	42%	30%	47%	..

The proportions of differences in excess of chance proportion for the first level of brightness range from 35% to 53%. The remarks made on Table 42 apply on the data of Table 57 all the more.

TABLE 58

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Second Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	26%	..				
N	40%	29%	..			
S	45%	31%	45%	..		
C	48%	31%	43%	45%	51%	..

The proportions of differences in excess of chance proportion for the second level of brightness range from 26% to 53% and therefore the observations made on Table 42 apply on the data of Table 58 as well.

TABLE 59

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Third Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	41%	..				
N	50%	41%	..			
S	50%	41%	47%	..		
C	54%	44%	52%	51%	..	
M	46%	37%	45%	42%	48%	..

The proportions of differences in excess of chance proportion for the third level of brightness range from 37% to 54%. The remarks made on Table 42 apply on the data of Table 59 all the more.

TABLE 60

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fourth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	39%	..				
N	46%	43%	..			
S	46%	45%	48%	..		
C	49%	48%	52%	54%	...	
M	43%	42%	47%	47%	51%	..

The proportions of differences in excess of chance proportion range between 39% and 54%. All are above the critical value of 25%. The remarks and comments made on Table 42 apply all the more to the data of the Table 60.

TABLE 61

Proportion of Differences in Excess of Chance Proportion (Expressed as Percentages) for All Pairs of Abilities for Fifth Level of Brightness

Abilities	*V*	*R*	*N*	*S*	*C*	*M*
V	..					
R	38%	..				
N	50%	47%	..			
S	46%	44%	60%	..		
C	41%	37%	45%	42%	..	
M	38%	33%	50%	43%	39%	..

The proportions of differences in excess of chance proportion for the fifth level of brightness range from 33% to 60% and all of them are above the critical value of 25 per cent. Therefore the remarks made on Table 61 apply very well to the data of Table 61.

Further it is noticed that the ranges of proportions of differences for the five levels of brightness do not show the decreasing trend in their values as was found earlier in case of classes eight and nine in particular.

CONCLUSION

The data of tables 42 to 61 has been summarised in Table 62. The range of the proportion of difference in excess of chance proportion (expressed as percentage) for different levels of brightness in classes eight, nine, ten and eleven have been shown therein and the medians have been written in the parantheses.

TABLE 62

Ranges of Proportions of Differences in Excess of Chances Proportion (Expressed as Percentages) for the Five Levels of Brightness, in Grade VIII, IX, X and XI.

Class	Level of Brightness				
	I	*II*	*III*	*IV*	*V*
VIII	34% to 47% (39%)	34% to 52% (41%)	33% to 46% (37%)	27% to 50% (36%)	25% to 48% (36%)
IX	27% to 52% (42%)	37% to 51% (43%)	34% to 53% (41%)	33% to 49% (38%)	24% to 45% (35%)
X	27% to 52% (44%)	33% to 53% (45%)	36% to 50% (44%)	38% to 49% (42%)	31% to 67% (43%)
XI	35% to 55% (44%)	26% to 53% (45%)	37% to 54% (46%)	39% to 54% (47%)	33% to 60% (43%)

From Table 62, two things become evident; firstly, the median proportion of differences in excess of chance increases with the grade for all levels of brightness that is the measurables differences in abilities increase with increase in age and educational experience. Secondly, the median proportion of differences in excess of chance decreases with the decrement in level of brightness, that is the measurable differences in abilities in duller children are less than those of brighter children.

VI. PATTERNS OF ABILITIES

A test profile is a convenient and popular method of summarising results of multiple measurement. It enables to have a picture of the total set of test scores of an individual and their inter-relations at a glance. The tests are represented by ordinates spaced along the horizontal base line and the magnitude of each score is represented by plotting point at the appropriate height on that ordinate.

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

Since raw test scores may vary considerably in meaning, they are not used in drawing the profile. They are reduced to some comparable form like the standard scores, percentile ranks, stanine grade, etc. Now if we can assume the means of different age groups as representative of their groups and convert them into standard scores with the help of combined mean and standard deviation for the whole grade then it is possible to draw the profiles for various groups and study the pattern of abilities.

Grade Eight

The standard scores in different abilities corresponding to the mean scores of 12 plus, 13 plus, 14 plus, 15 plus and 16 plus age groups, that is of levels of brightness one through five are set out in Table 63.

TABLE 63

Standard Scores Corresponding to Mean Ability Scores of different Age Groups of Grade VIII

Age group/ Abilities	*V*	*R*	*N*	*S*	*C*	*M*
12+	·5630	·2412	·4734	·1208	·2471	·2142
13+	·1731	·0004	·1680	·1740	·1363	·1528
14+	—·3018	·3561	—·2039	—·0976	·1418	—·2961
15+	—·3817	—·4894	—·4169	—·3121	—·2973	—·0525
16+	—·6815	—·2083	—·6655	—·2192	—·1921	—·5199

The profiles for the average performance of these age groups are shown in figure 9.

From Figure 9 it is noticed that the profiles of different groups were not similar, that is, they did not show the same pattern of strengths and weaknesses. The twelve year group was strong in verbal and numerical abilities and its weakest abilities were spatial and mechanical. No doubt, it being the brightest group, all the standard scores lay above the horizontal line of zero standard score.

Almost all the abilities of the thirteen year age group were of the same level except the reasoning ability which was its greatest weakness, being the second group in terms of brightness, all the standard scores lay above the horizontal line of zero standard scores.

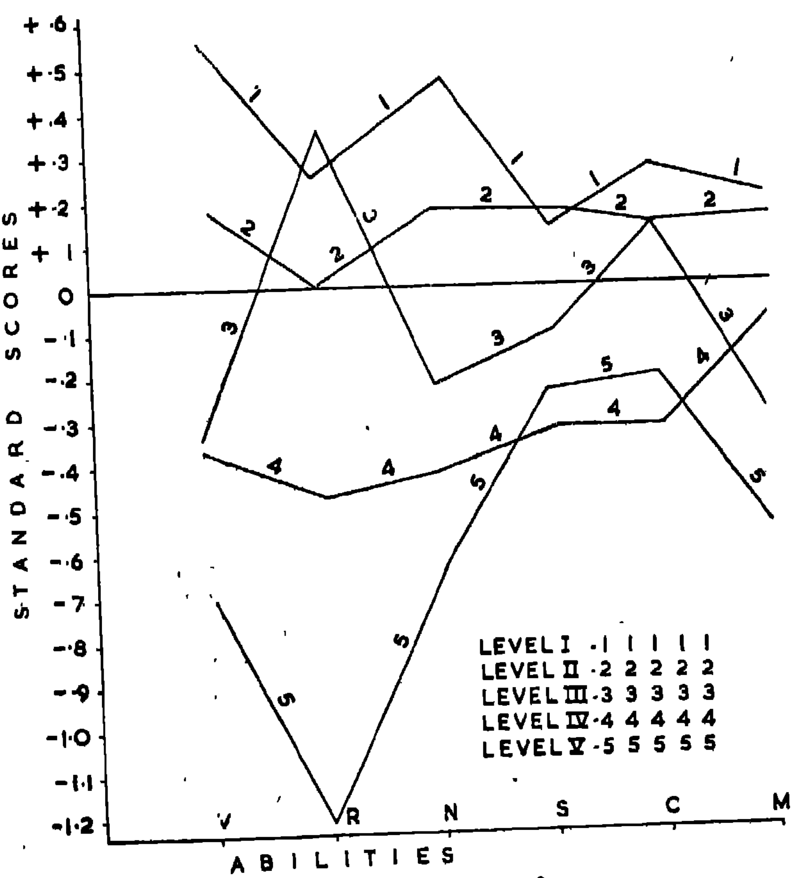
The fourteen year age group represented the middle level of brightness and its scores on two abilities were positive and on four were negative.

The strengths of this group happened to be reasoning and clerical abilities and the weaknesses were the verbal and mechanical.

The fifteen year age group, which represented the fourth level of brightness, had negative standard scores in all the abilities; its strengths were mechanical and clerical abilities and its weaknesses were reasoning and numerical abilities. The sixteen year age group, being the dullest, had all the negative standard scores, its strengths were clerical and spatial abilities and the weaknesses were reasoning and verbal.

FIGURE 9

Ability Profiles of Five Levels of Brightness at the Eighth Grade



Grade Nine

The standard scores in different abilities corresponding to the mean scores of 13 plus, 14 plus, 15 plus, 16 plus and 17 plus age groups, that is of the five levels of brightness are set out in Table 64.

TABLE 64

Standard Scores Corresponding to Mean Ability Scores of Different Age Groups of Grade IX

Age group/ Abilities	*V*	*R*	*N*	*S*	*C*	*M*
13+	·3075	·2695	·3753	·2568	·1460	·1991
14+	·1284	·1254	·1408	·0749	·0533	·1058
15+	—·1880	—·1068	—·0103	—·0286	·0039	—·0776
16+	—·0325	—·1748	—·3518	—·3258	—·1466	—·2531
17+	—·0158	—·3694	—·5529	—·0787	—·2130	—·1160

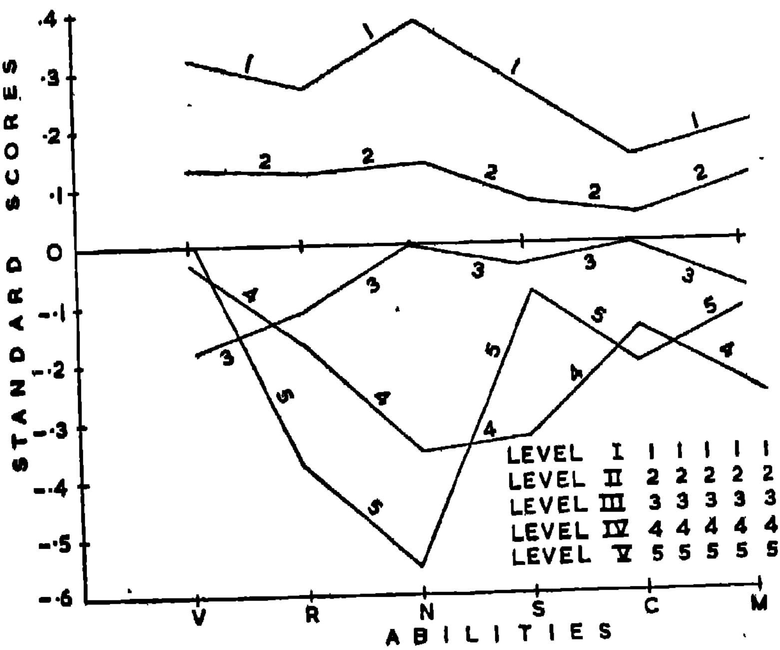
The profiles for the average performance of these age groups are shown in Figure 10.

From Figure 10 it is noticed that although the profiles of different age groups were not exactly similar but the dis-similarities were lesser than those observed at the eighth grade. The thirteen year age group was strong in numerical and verbal abilities and weakest in mechanical and clerical. Being the brightest group, however, all the standard scores were positive and above the horizontal line of zero standard score.

All the abilities of the fourteen year age group were almost of the same level and all its standard scores were above the horizontal line of zero standard score. The profile of this group lay below that of the first group and was almost parallel to the former.

FIGURE 10

Ability Profiles for Five Levels of Brightness at the Ninth Grade



ABILITIES

The fifteen year age group had all its standard scores slightly below the average line. Its strengths were clerical and numerical; its weaknesses were verbal and mechanical.

The sixteen year age group, which represented the fourth level of brightness had negative standard scores in all the abilities; its strengths were verbal and clerical and its weaknesses were numerical and spatial.

The best abilities of the seventeen year age group were verbal and spatial and the weakest were numerical and reasoning abilities. It being the dullest group naturally all the standard scores were negative.

Grade Ten

The standard scores in different abilities corresponding to the mean scores of 14 plus, 15 plus, 16 plus, 17 plus and 18 plus age group, that is, of the five levels of brightness are set out in Table 65.

TABLE 65

Standard Scores Corresponding to Mean Ability Scores of Different Age Groups of Grade X

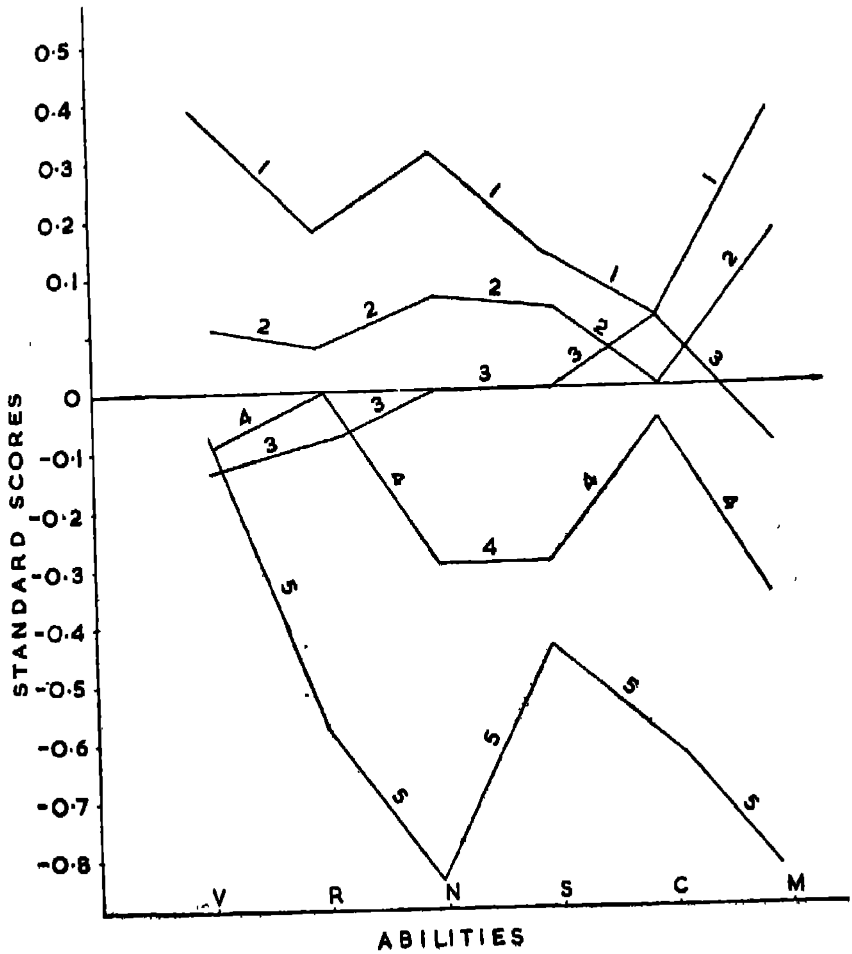
Age groups/ Abilities	*V*	*R*	*N*	*S*	*C*	*M*
14+	·4455	·2683	·3896	·2333	·1200	·4355
15+	·1109	·0793	·1627	·1382	·0114	·2352
16+	—·1327	—0·0776	—·0016	·0008	·1148	—·0713
17+	—·0884	—0·0030	—·2807	—·2767	—·0492	—·3498
18+	—·0655	—0·5435	—·8040	—·4241	—·5721	—·7843

The profiles for the average performance of these age group are shown in Figure 11.

It is noticed from Figure 11 that the profiles of the different groups are not intersecting each other. The profiles of 14 year and 15 year age groups are more or less similar and the profiles of 17 year and 18 year g e groups are also more or less alike but different from the former.

FIGURE 11

Ability Profiles for Five Levels of Brightness at the Tenth Grade



The verbal and mechanical abilities of the fourteen year age group appeared to be its strengths while clerical ability was the weakness of this brightest group. However all the standard scores were positive.

The fifteen year age group had also all its standard scores above the line of zero standard score. Its strengths were the mechanical and numerical abilities and the weaknesses were the clerical and reasoning abilities.

The sixteen year age group which represented the middle level of brightness was strong in clerical ability and weak in verbal ability.

The seventeen year age group had all its standard scores below zero standard score; the reasoning and clerical abilities were its strengths and the mechanical, numerical and spatial were its weaknesses.

The eighteen year age group representing the lowest level of brightness was weak in numerical and mechanical abilities and strong in verbal ability.

Grade Eleven

The standard scores in different abilities corresponding to the mean scores of 15 plus, 16 plus, 17 plus, 18 plus and 19 plus age groups, that is, of the five levels of brightness are set out in Table 66.

TABLE 66

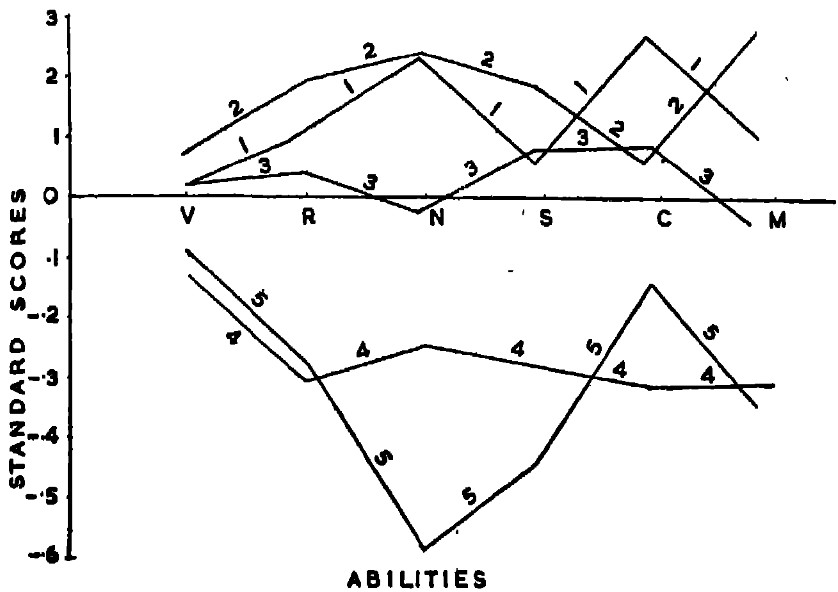
Standard Scores Corresponding to Mean Ability Scores of Different Age Groups

Age groups/ Abilities	*V*	R	*N*	*S*	*C*	*M*
15+	·0176	·1055	·2294	·0584	·2659	·0968
16+	·0676	·1878	·2416	·1904	·0615	·2797
17+	·0262	·0431	—·0176	·0749	·0851	—·0458
18+	—·1215	—·3228	—·2381	—·2555	—·3112	—·3112
19+	—·0910	—·2652	—·5844	—·4345	—·1441	—·3543

The profiles for the average performance of these age groups are shown in Figure 12.

FIGURE 12

Ability Profile for Five Levels of Brightness at the 11th Grade



The profiles of 15 plus, 16 plus and 17 plus age groups are overlapping and those of 18 plus and 19 plus age groups are also over-lapping. The former groups represent the first, second and third levels of brightness and the latter groups represent the fourth and fifth levels of brightness. It thus appeared that with the growths of abilities for different levels of brightness the differences in their performances narrowed down and there appeared to be only two patterns one for the above average and average, and another for below average.

For the 15 plus and 16 plus age groups the strengths were numerical and clerical and the weaknesses were verbal, spatial and mechanical.

For the 16 plus age group the strengths were numerical and clerical and the weaknesses were verbal, spatial and mechanical. The strengths of the 16 plus age groups were numerical and mechanical and the weaknesses were clerical and verbal.

For the 17 plus age group the strengths were clerical and spatial and the weaknesses were mechanical and numerical.

For the 18 plus age group, all the standard scores were almost of the same level, the verbal ability appeared to be its strengths and the reasoning and clerical abilities to be its weaknesses.

For the lowest level of brightness, that is 19 plus age group, the weaknesses were numerical and spatial and the strengths were verbal and clerical.

Patterns of Abilities

The patterns of abilities for the various levels of brightness at different grades have been summarised in Tables 67, 68, 69, 70. The abilities have been arranged in descending order from left to right.

TABLE 67

Patterns of Abilities for Different Levels of Brightness at Grade VIII

Level of Brightness	Abilities in Rank Order					
	1	2	3	4	5	6
I	V	N	C	R	M	S
II	S	V	N	M	C	R
III	R	S	C	N	M	V
IV	M	C	S	V	N	R
V	C	S	M	N	V	R

TABLE 68

Patterns of Abilities for Different Levels of Brightness at Grade IX

Level of Brightness	Abilities in Rank Order					
	1	2	3	4	5	6
I	N	V	R	S	M	C
II	N	V	R	M	S	C
III	C	N	S	M	R	V
IV	V	C	R	M	S	N
V	V	S	M	C	R	N

TABLE 69

Patterns of Abilities for Different Levels of Brightness at Grade X

Level of Brightness	Abilities in Rank Order					
	1	2	3	4	5	6
I	V	M	N	R	S	C
II	M	N	S	V	R	C
III	C	S	N	M	R	V
IV	R	C	V	S	N	M
V	S	R	C	V	M	N

TABLE 70

Patterns of Abilities for Different Levels of Brightness at Grade XI

Level of Brightness	Abilities in Rank Order					
	1	2	3	4	5	6
I	C	N	R	M	S	V
II	M	N	S	R	V	C
III	C	S	R	V	N	M
IV	V	N	S	C	M	R
V	V	C	R	M	S	N

From the above tables it appears that the patterns of abilities for different levels of brightness within a class or for a level of brightness in different grades did not remain the same.

Analysis of Variance

An analysis of variance test for the existence of group psychometric patterns and configurations of test scores was used. This method (Block, Levine & McNemar, 1951) depends upon the fact that profile differences from group to group are reflected in the interaction term of level X test variables. The error term is the individual X test variables interaction

obtained separately for each group, then summed over groups; this error term appears as the 'residual' in the tables that follow. The technique yields an estimate of the difference in profiles that is independent of the different levels at which several profiles may fall.

TABLE 71

Analysis of Variance for Patterns of Abilities

Grade	*Sources of Variation*	*d.f.*	*Mean Sum of Square*	*Variance Ratio=F*
VIII	Tests	5	0·0283	0·4772
	Levels	4	0·7588	12·7960*
	Error	20	0·0593	
	Total	29		
IX	Tests	5	0·0079	0·5232
	Levels	4	0·2622	17·3642*
	Error	20	0·0151	
	Total	29		
X	Tests	5	0·177	0·6604
	Levels	4	0·6173	23·0336*
	Error	20	0·0268	
	Total	29		
XI	Tests	5	0·0077	0·3182
	Levels	4	0·5247	10·5248*
	Error	20	0 0242	
	Total	29		

Table 71 indicates that there are differences in levels of brightness at all the grades but the non-significant F ratios for the tests indicated that the patterns of abilities were not different, indeed the patterns for the five levels of brightness at each grade were similar.

While class and age intoract to affect level of performance but no such interaction affect is shown on the pattern of mental abilities. The failure of the level of brightness to transcend patterns of mental ability is quite understandable. In any field of work there can be found a hierarchy of occupations which will require the same pattern of abilities but at different levels of brightness.

CONCLUSION

While there were differences in brightness levels but no differences were found to exist in patterns of abilities of pupils belonging to the different levels of brightness at any grade.

VII. SUMMARY AND CONCLUSIONS

The need for studying the stabilization of abilities and interests and their patterns in the adolescent period of higher secondary children arose from the present school system wherein, at one point or another, pupils are called upon to choose among several different curricula.

Keeping in view the various advantages and limitations of two approaches—longitudinal and cross-sectional, a combination of these approaches was attempted. Students reading in classes VIII, IX, X and XI in 1963 were the subjects of cross-sectional study whereas the eighth class students were tested year after year for four years till they left the higher secondary schools in 1967. This report presents the results of cross-sectional study.

Five schools representing all the three levels of efficiency—good, average and below average—as judged from their last three years results at the Higher Secondary Examination and having approximately the same number of students in classes eight, nine, ten and eleven were selected for the study. The schools had all the courses: humanities, science and commerce, and the parental occupations and socioeconomic levels represented a wide range.

There was large variability of ages in each grade and pupils of ages below and above the modal age—which was 13 years for class VIII, 14 years for class IX, 15 years for class X and 16 years for class XI were found in each grade. The subjects were, therefore, divided in to homogeneous age-cum-grade groups. Excluding the groups which had few students in them, five age groups were considered in each grade.

Of the 2,403 students included in the age-cum-grade groups 1,660 students took all the tests; others were absent in one or more tests due to various reasons, but they were not truants or victims of some other bad habits. Also the exclusion of incomplete data did not affect the nature of the distributions of ability scores; the central tendency and dispersion of the different ability scores remained unaffected.

Six abilities—Verbal (V), Deductive Reasoning (R), Numerical (N), Spatial (S), Clerical Speed and Accuracy (C) and Mechanical (M) were

selected for the investigation for which reliable tests were available for grades eighth through eleven.

The tests were administered by trained testers of the Central Bureau of Educational and Vocational Guidance in school hours during September November 1963. The testing programme for one section of a grade was spread over three sessions, held on three consecutive days and each session was of two hours duration. The data was scored on machines.

1. Grade and age were found to exert differential effect on the abilitiy scores and the data permitted a study of the development and sabstlisation of abilities for five different groups of brightness labelled as First, Second, Third, Fourth and Fifth levels of Brightness.

2. The growth curves, or better age progress curves, for the six abilities—verbal, reasoning, spatial, numerical, clerical and mechanical exhibited different characteristics. The growth curves for verbal and reasoning were almost similar; the brighter groups began at a higher level but grew at a slower rate than the duller groups so that the differences between the groups of varying brightness, noticed at the eighth grade, tended to decrease at the eleventh grade. The growth curves for numerical, clerical and mechanical had 174 almost similar characteristics; the rate of growth for pupils of different degrees of brightness was almost equal and therefore the differences between the ability scores for the five levels, noticed at the eighth grade, were maintained throughout the three year period. The growth curves of spatial ability indicated that the brighter groups not only began at a higher level but tended to grow at a faster rate so that the differences between the brighter and duller groups, observed at the eighth grade, had increased at the eleventh grade.

The growth of abilities for the modal age group indicated that the growth characteristics of verbal, reasoning and clerical abilities were almost similar, all these abilities continued to grow throughout the higher secondary classes while the rate of growth was maximum from class IX to class X. The growth of spatial and mechanical abilities again were similar; there was retardation from class VIII to class IX but continuous throughout the three year period, but there was high acceleration from class X to XI when the scores exceeded the scores of all other abilities at class XI.

The application of Kelley's formula for appraising the communality or disparity between the traits showed, firstly, that the measureable

differences in abilities increased with age and educational experience; and secondly, that the measureable differences in abilities decreased with the decrement in level of brightness *i.e.*, the differentiation of abilities was more pronounced in brighter children.

While class and age interacted to affect level of performance, no such interaction affect was shown on the pattern of mental abilities. Indeed the patterns for the five levels of brightness at each grade were similar. It is quite understandable too; one can find a hierarchy of occupations which will require the same pattern of abilities but at different levels of brightness.

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

Appendix—II

FORMULAE

Skewness

$$V_1 = M_3^2 / M_2^3$$

Where, M_2: Second Moment of the distribution about its Mean.

M_3: Third Moment of the distribution about its Mean.

Kurtosis

$$V_2 = M_4 / M_2^2 - 3$$

Where M_4: Fourth Moment of the distribution about its Mean. The significance of skewness was tested by the critical ratio

V_1 / Standard Error of V_1

Which has normal distribution with Mean Zero and Variance one.

Where S.E. of $V_1 = \frac{6N(N-1)}{(N-2)(N+1)(N+3)}$, N=Total frequency.

Difference between means

The significance of difference between means of consecutive pairs of groups for each level of brightness was tested by determining the Critical Ratio and interpreting the letter with the help of normal distribution in case of large samples ($N>30$) and with the help of t- distribution in case of small samples ($N \angle 30$)

C.R. = Difference Between Means/S.E. of Difference Between Means ($S.E.D_M$)

Where $S.E.D_M = \sqrt{(S.E.M_1)^2 + (S.E.M_2)^2}$ When $N>30$

$$S.E_M = \frac{S.D.}{\sqrt{N}}$$

$$\text{and } S.E.D_M = \sqrt{\left(\frac{X_1^2 + X_2^2}{N_1 + N_2 - 2}\right)\left(\frac{N_1 + N_2}{N_1 N_2}\right)}$$

When $N \leq 30$.

X^2 = sum of squares in sample

The results are set out in Tables 26, 27, 28, 29.

Difference Between Medians

As the distributions of reasoning ability were significantly negatively skewed the Median Test (138) was used to determine the differences in central tendencies of various age-cum-grade groups.

To perform the test, the median score for the combined group was determine for each pair of group. Then both sets of scores were dichotomised at that combined median and the value of Chi-Square was worked out by using the following formula:

$$\text{Chi-Square} = \frac{N\left(AD - BC - \frac{N}{2}\right)^2}{(A + B)\ (C + D)\ (A + C)\ (B + D)}$$

Where, A and B are the number of scores above combined median for the two groups, C and D are the number of scores below combined median for the same groups.

N is the number of scores in the two groups:

The Chi-Square test was used with the degree of freedom to determine the significance of difference between the medians. The results are shown in Tables 31 and 33.

Disparity Among Abilities

If 'z_1' and 'z_2' are the standard scores in abilities of an individual and 'd' denotes the difference between these standard scores *i.e.* $d = z_1 - z_2$. *Is the difference significant or is it a chance difference, due to the fact that we have inaccurate measures of both the abilities.*

If we have N pupils there will be N values of difference and the standard deviation of this d's is, by the use of formula for the standard deviation of a difference, is given by:

$$\sigma d = \sqrt{\overline{z_1^2} + \overline{z_2^2} - 2r_{12}\,\overline{z_1 z_2}}$$

$$= \sqrt{2 - 2r_{12}} \qquad (i)$$

In which r_{12} is the correlation between the ability scores.

It is important to note that this is the standard deviation of the distribution of d's but it is not at all the standard error of a single 'd'.

Let the true scores corresponding to z_1 and z_2 be z_∞ (z_∞ subinfinity) and z_ω (z sub-omega) and then one needs to calculate $\sigma d - \infty - \omega$.

That is a standard deviation of the d's for constant values of Z_∞ and z_ω which will be given by:

$$\sigma d - \infty - \omega = \sqrt{2 - r_{tt}(1) - r_{tt}(2)}$$

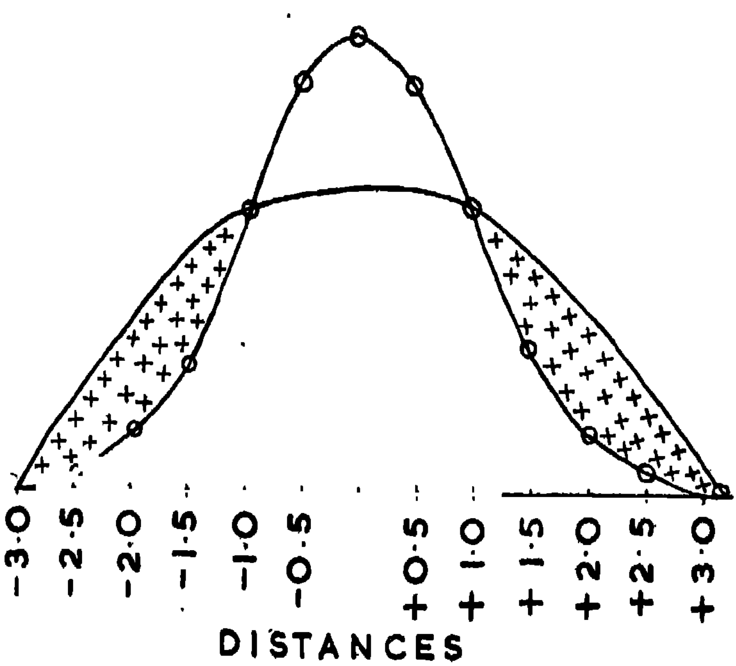
This formula makes possible the determination of the probable errors of judgements of difference of abilities within the individuals.

$$\text{P.E. (of Individual } z_1 - z_2) = \cdot 6745\sqrt{2 - r_{tt}(1) - r_{tt}(2)}$$

If the distribution of differences for the entire population should have the same standard deviation as this, then obviously, the obtained differences are no greater than chance indicates. However, the standard deviation for the group, of obtained differences is σd and this standard deviation is greater than the former for every combination by two's of the tests in the battery. The type of situation is pictured in the figure drawn below:

FIGURE 13

Distribution of σd-∞ -ω and σd



σ-Distances.

The dotted curve is a distribution of σd-∞ -ω and the full line curve is a distribution of the same total area of σd should the full line curve coincide the dotted line curve then the differences found would, on the whole, be greater than chance suggests, but if the full line curve has the greater standard deviation then, for the proportion of cases represented by the shaded area the obtained differences are greater than chance suggests. The proportion represented by the shaded area depends upon the ratio of the standard deviations, σd-∞ -ω and σd. The proportion, knowing the ratio can be read from the table given below:

TABLE

Proportion of Differences in Excess of the Chance Proportion

σd-∞ -$\omega/\sigma d$	*Proportions*	σd-∞ -$\omega/\sigma d$	*Proportions*
·02	·950	·70	·171
·05	·888	·75	·138
·10	·798	·80	·108
·15	·719	·85	·078
·20	·647	·90	·051
·25	·582	·95	·025
·30	·522	·99	·005
·35	·467		
·40	·415		
·45	·367		
·50	·323		
·55	·281		
·60	·242		
·65	·205		

The ratios represent the proportion of differences in excess of the chance proportion, or in other words, differences not attributable to either the unreliability of the tests or to the overlapping of measurement by them.

Segal states that when the proportion of differences is 25% or more, it may be regarded as indicative of disparity among the mental traits (127).

Appendix—III

FREQUENCY DISTRIBUTIONS

TABLE (I)

Frequency Distribution of 'V' Scores of Class VIII Students

Raw Scores	Ages 12+	13+	14+	15+	16+	Total
60–64	..	..	..	1	..	1
55–59	1	2	..	..	..	3
50–54	9	12	2	1	..	24
45–49	8	14	1	1	..	24
40–44	14	21	4	4	1	44
35–39	11	22	11	4	..	48
30–34	13	20	14	8	..	55
25–29	10	29	18	16	2	75
20–24	13	27	12	17	1	70
15–19	3	18	30	14	4	69
10–14	2	13	16	13	4	48
5–9	2	9	12	10	3	36
0–4	2	12	3	7	..	24
Total	88	199	123	96	15	521
Mean	33·648	28·432	22·080	21·010	17·000	26·117
S.D.	12·474	13·895	10·895	11·890	9·129	13·377

TABLE (II)

Frequency Distribution of 'V' Scores of Class IX Students

Raw Scores	Ages 13+	14+	15+	16+	17+	Total
60–64	..	2	..	..	..	2
55–59	..	6	1	..	..	7
50–54	10	9	2	..	..	21
45–49	6	15	9	..	..	30
40–44	8	18	8	8	2	44
35–39	10	35	19	6	6	76
30–34	14	25	14	15	5	73
25–29	4	22	14	15	9	64
20–24	5	24	22	9	10	70
15–19	3	9	10	9	6	37
10–14	6	7	8	2	..	23
5–9	2	13	8	6	2	31
0–4	1	5	4	7	4	21
Total	69	190	119	77	44	499
Mean	33·522	31·316	27·420	29·338	23·93	29·735
S.D.	13·320	13·671	12·579	11·799	10·665	12·312

TABLE (III)

Frequency Distribution of 'V' Scores of Class X Students

Raw Scores	Ages					
	14+	15+	16+	17+	18+	Total
60–64	1	..	..	1	..	2
55–59	3	7	2	..	..	12
50–54	12	10	3	1	..	26
45–49	11	9	9	9	..	38
40–44	6	21	20	11	4	62
35–39	7	15	13	6	3	44
30–34	6	19	21	11	3	60
25–29	9	13	16	8	10	56
20–24	3	7	11	8	7	36
15–19	..	2	5	1	1	9
10–14	..	1	1	1	2	5
5–9	..	3	..	..	..	3
0–4	1	1	1	1	..	4
Total	59	108	102	58	30	357
Mean	40·475	36·675	33·910	34·414	28·000	35·417
S.D.	11·754	11·849	10·075	10·892	8·104	11·353

TABLE (IV)

Frequency Distribution of 'V' Scores for Class XI Students

Raw Scores	Ages					
	15+	16+	17+	18+	19+	Total
60–64	1	4	1	1	..	7
55–59	2	2	3	..	..	7
50–54	4	10	12	6	4	36
45–49	4	8	16	7	4	39
40–44	3	20	8	11	4	49
35–39	6	25	9	4	3	47
30–34	4	13	10	8	3	38
25–29	3	8	6	10	3	30
20–24	1	4	5	6	2	18
15–19	3	2	1	..	1	7
10–14	..	..	1	..	1	2
5–9	..	..	2	..	..	2
0–4	..	..	1	..	..	1
Total	31	96	75	53	28	283
Mean	42·175	39·344	38·870	37·189	37·536·	38·5733
S.D.	12·285	9·762	13·645	10·283	10·884	11·400

TABLE (v)

Frequency Distribution of R Scores of Class VIII Students

Raw Scores	Ages 12+	13+	14+	15+	16+	Total
48–50	..	1	..	..	..	1
45–47	9	20	3	..	..	32
42–44	23	34	12	5	1	75
39–41	21	37	21	16	1	96
36–38	11	31	30	12	..	84
33–35	9	25	25	21	1	81
30–32	10	14	5	14	..	43
27–29	..	21	16	13	4	54
24–26	2	6	8	6	4	26
21–23	..	..	1	4	3	8
18–20	2	4	1	3	..	10
15–17	1	3	..	1	1	6
12–14	..	1	1	1	..	3
9–11	..	1	..	..	..	1
6–8	..	1	..	..	..	1
3–5	..	..	..	..	..	..
Total	88	199	123	96	15	521
Mean	38·250	36·447	39·110	32·731	27·400	36·4449
S.D.	6·399	7·615	6·534	6·818	6·770	7·485

TABLE (vi)

Frequency Distribution of R Scores of Class IX Students

Raw Scores	Ages 13+	14+	15+	16+	17+	Total
48–50	1	2	..	..	..	3
45–47	4	19	3	2	..	28
42–44	15	31	18	9	6	79
39–41	14	38	19	16	2	89
36–38	16	37	22	11	11	97
33–35	8	25	22	13	6	74
30–32	6	13	19	9	6	53
27–29	4	12	6	9	5	36
24–26	1	2	4	3	4	14
21–23	..	5	1	4	3	13
18–20	..	2	2	..	1	5
15–17	..	2	2	..	..	4
12–14	..	1	..	..	..	1
9–11	..	1	..	..	..	1
6–8	..	..	..	1	..	1
3–5	..	..	1	..	..	1
Total	69	190	119	77	44	499
Mean	38·044	36·947	35·180	34·662	33·18	35·993
S.D.	5·166	7·218	7·315	6·843	6·471	7·610

TABLE (vii)

Frequency Distribution of R Scores of Class X Students

Raw Scores	Ages 14+	15+	16+	17+	18+	Total
48–50	..	..	..	1	..	1
45–47	9	13	4	5	..	31
42–44	17	26	26	14	5	88
39–41	13	26	31	15	6	91
36–38	12	21	22	9	6	70
33–35	4	12	3	9	5	33
30–32	3	5	8	1	2	19
27–29	..	1	1	..	3	5
24–26	1	1	2	1	1	6
21–23	..	3	2	1	..	6
18–20	..	..	1	1	1	3
15–17	..	..	..	..	1	1
12–14	..	..	1	..	..	1
9–11	..	..	1	1	..	2
Total	59	108	102	58	30	357
Mean	40·051	38·898	37·940	38·397	35·100	38·415
S.D.	4·543	5·516	6·426	6·772	6·818	6·098

TABLE (viii)

Frequency Distribution of R Scores of Class XI Students

Raw Scores	Ages 15+	16+	17+	18+	19+	Total
48–50	1	3	...	1	..	5
45–47	7	13	14	5	2	41
42–44	4	29	22	12	7	74
39–41	9	24	19	11	7	70
36–38	6	14	5	7	3	35
33–35	2	10	7	7	6	32
30–32	1	2	2	2	2	9
27–29	..	..	3	5	..	8
24–26	..	1	1	1	..	3
21–23	..	..	1	1	..	2
18–20	1	..	..	..	..	1
15–17	..	..	..	..	..	0
12–14	..	..	1	..	..	1
9–11	..	..	..	..	1	1
6–8	..	..	..	1	..	1
3–5	..	..	..	..	..	0
0–2	..	..	..	..	..	0
Total	31	36	75	53	28	283
Mean	40·097	40·594	39·720	37·509	37·857	39·459
S.D.	5·821	4·343	6·181	7·4358	6·843	6 042

TABLE (ix)

Frequency Distribution of N Scores of Class VIII Students

Raw Scores	Ages					
	12+	13+	14+	15+	16+	Total
33-35	...	...	...	...	..	...
30-32	..	..	..	..	..	..
27-29	1	1	..	..	..	2
24-26	..	..	..	..	..	..
21-23	3	9	2	1	...	15
18-20	7	10	2	1	..	20
15-17	8	13	8	3	..	32
12-14	17	27	8	2	..	54
9-11	16	44	14	8	3	85
6-8	20	41	34	31	1	127
3-5	9	29	27	24	5	94
0-2	7	25	28	26	6	91
Total	88	199	123	96	15	521
Mean	10·443	8·769	6·780	5·563	4·200	7·848
S.D.	5·691	5·717	4·973	3·942	3·371	5·482

TABLE (x)

Frequency Distribution of N Scores of Class IX Students

Raw Scores	Ages					
	13+	14+	15+	16+	17+	Total
33-35	...	1	..	..	..	1
30-32	..	1	1	..	..	2
21-29	..	3	..	..	..	3
24-26	2	6	1	..	..	9
21-23	8	8	5	..	..	21
18-20	7	9	6	2	..	24
15-17	8	25	6	6	3	48
12-14	10	16	16	7	1	50
9-11	14	38	28	14	9	103
6-8	4	30	25	16	9	84
3-5	7	25	16	14	7	69
0-2	9	28	15	18	15	85
Total	69	190	119	77	44	499
Mean	11·913	10·379	9·390	7·156	5·840	9·458
S.D.	6·978	7·137	6·755	5·032	4·532	6·543

TABLE (xi)

Frequency Distribution of N Scores of Class X Students

Raw Scores	Ages					
	14+	15+	16+	17+	18+	Total
33–35	..	..	..	..	..	..
30–32	..	1	3	..	..	4
27–29	1	4	2	..	..	7
24–26	6	8	3	1	..	18
21–23	10	7	4	1	..	22
18–20	4	12	11	2	..	29
15–17	5	11	10	11	1	38
12–14	11	7	8	4	1	31
9–11	9	20	23	11	5	68
6–8	3	16	12	10	7	48
3–5	8	9	8	6	3	34
0–2	2	13	18	12	13	58
Total	59	108	102	58	30	357
Mean	14·271	12·528	11·260	9·121	5·900	11·277
S.D.	7·332	7·939	7·819	6·207	4·277	7·684

TABLE (xii)

Frequency Distribution of N Scores of Class XI Students

Raw Scores	Ages					
	15+	16+	17+	18+	19+	Total
33–35	..	3	1	...	..	4
30–32	1	4	6	2	..	13
27–29	3	9	3	2	..	17
24–26	3	10	12	5	2	32
21–23	5	10	...	2	1	18
18–20	2	13	4	7	2	28
15–17	4	16	11	6	5	42
12–14	7	10	8	3	1	29
9–11	5	7	14	11	6	43
6–8	..	5	7	4	2	18
3–5	1	3	2	6	4	16
0–2	..	6	7	5	5	23
Total	31	96	75	53	28	283
Mean	17·645	17·750	15·520	13·623	10·643	15·671
S.D.	6·834	8·348	9·020	8·452	7·320	8·604

TABLE (xiii)

Frequency Distribution of 'S' Scores for Class VIII Students

Raw Scores	Ages 12+	13+	14+	15+	16+	Total
55–	...	1	..	..	..	1
50–	...	3	1	..	..	4
45–	4	7	1	1	..	13
40–	3	14	5	3	1	26
35–	4	19	7	1	1	32
30–	17	33	18	89	1	78
25–	17	24	20	10	3	74
20–	11	23	10	20	..	64
15–	12	20	21	17	3	73
10–	12	30	17	13	4	76
5–	3	10	17	17	..	47
0–	5	15	6	5	2	33
Total	88	199	123	96	15	521
Mean	23·705	24·337	21·110	18·563	19·667	22·70
S.D.	11·061	12·828	11·312	10·061	11·528	11·877

TABLE (xiv)

Frequency Distribution of 'S' Scores for Class IX Students

Raw Scores	Ages 13+	14+	15+	16+	17+	Total
55–	..	..	..	..	..	..
50–	..	1	1	1	..	3
45–	3	9	3	..	..	15
40–	7	8	7	4	1	27
35–	7	17	8	6	3	41
30–	5	26	8	2	2	43
25–	17	27	24	11	11	90
20–	7	24	15	13	9	68
15–	12	30	14	5	8	69
10–	3	18	21	11	6	59
5–	5	17	13	12	2	49
0–	3	13	5	12	2	35
Total	69	190	119	77	44	499
Mean	25·333	23·158	21·920	18·364	21·320	22·262
S.D.	11·716	12·171	11·650	12·582	9·020	11·963

TABLE (xv)

Frequency Distribution of 'S' Scores for Class X Students

Raw Scores	Ages 14+	15+	16+	17+	18+	Total
55–59	1	1	..	..	..	2
50–54	1	5	6	1	..	13
45–49	6	5	5	3	1	20
40–44	6	14	9	2	2	33
35–39	5	14	11	6	2	38
30–34	11	11	20	5	5	52
25–29	10	22	4	7	3	46
20–24	8	10	13	6	4	41
15–19	5	6	13	12	1	27
10–14	3	10	7	10	4	34
5–9	2	5	7	5	4	23
0–4	1	5	7	1	4	18
Total	59	108	102	58	30	357
Mean	29·881	28·620	26·800	23·121	21·167	26·789
S.D.	12·006	13·191	13·614	12·105	13·354	13·257

TABLE (xvi)

Frequency Distribution of 'S' Scores for Class XI Students

Raw Scores	Ages 15+	16+	17+	18+	19+	Total
55–	..	1	2	1	..	4
50–	4	5	3	2	2	16
45–	4	12	4	1	..	21
40–	2	16	10	3	3	34
35–	3	15	12	6	2	38
30–	4	9	7	11	3	34
25–	5	12	14	6	4	41
20–	2	7	11	7	3	30
15–	2	8	6	5	5	26
10–	..	8	3	6	2	19
5–	2	1	2	3	1	9
0–	3	2	1	2	3	11
Total	31	96	75	53	28	283
Mean	30·080	32·469	30·930	26·528	24·143	29·932
S.D.	15·757	12·790	11·953	12·833	13·851	13·324

TABLE (xvii)

Frequency Distribution of 'C' Scores for Class VIII Students

Raw Scores	Ages					
	12+	13+	14+	15+	16+	Total
95–99	..	..	..	..	..	..
90–94	..	..	..	..	..	..
85–89	..	..	..	..	..	..
80–84	..	1	..	..	..	1
75–79	..	2	..	..	..	2
70–74	3	1	..	..	..	4
65–69	1	4	1	1	..	7
60–64	2	11	2	4	..	19
55–59	6	14	3	..	..	23
50–54	8	19	3	2	..	32
45–49	25	25	21	18	3	92
40–44	11	30	20	17	3	81
35–39	7	33	32	18	5	95
30–34	11	21	14	6	1	53
25–29	7	15	12	8	1	43
20–24	4	11	9	7	1	32
15–19	2	4	4	6	1	17
10–14	1	3	2	4	..	10
5–9	..	5	..	4	..	9
0–4	..	..	..	1	..	1
Total	88	199	123	96	19	521
Mean	42·455	40·995	37·330	35·281	36·667	39·199
S.D.	12·449	14·164	10·296	13·781	12·242	13·178

TABLE (xviii)

Frequency Distribution of 'C' Scores for Class IX Students

Raw Scores	Ages					
	13+	14+	15+	16+	17+	Total
95–99	..	..	1	..	..	8
90–94	..	..	..	..	..	..
85–89	..	1	1	..	..	2
80–84	..	4	1	..	..	5
75–79	4	4	1	..	..	9
70–74	2	3	3	1	..	9
65–69	3	3	3	2	..	11
60–64	8	16	7	3	5	39
55–59	5	22	13	10	4	54
50–54	9	18	17	14	2	60
45–49	9	31	18	15	7	80
40–44	10	21	19	9	8	67
35–39	8	24	15	5	8	60
30–34	3	20	9	6	3	41
25–29	3	9	2	1	2	17
20–24	1	3	1	2	3	10
15–19	1	2	1	3	1	8
10–14	1	1	..	1	..	3
5–9	2	1	1	1	..	5
0–4	..	5	6	4	1	16
Total	69	190	119	77	44	499
Mean	47·580	46·079	45·280	42·844	41·770	45·217
S.D.	16·009	16·530	16·505	16·006	13·184	16·179

TABLE (xix)

Frequency Distribution of 'C' Scores for Class X Students

Raw Scores	Ages					
	14+	15+	16+	17+	18+	Total
95–	1	1	1	..	..	3
90–	..	..	1	..	..	1
85–	1	..	..	2	..	3
80–	..	2	2	..	..	4
75–	3	2	4	3	..	12
70–	2	4	6	1	..	13
65–	6	8	3	4	..	21
60–	4	14	13	4	..	36
55–	9	16	12	3	3	43
50–	11	10	15	9	4	54
45–	8	18	17	11	6	60
40–	4	11	12	5	5	37
35–	4	5	5	11	3	28
30–	2	2	5	2	3	14
25–	..	3	3	1	3	10
20–	1	..	2	1	..	4
15–	1	1	..	..	..	2
10–	..	..	..	..	..	..
5–	..	1	..	..	2	3
0–	2	5	1	1	..	9
Total	59	108	102	58	30	357
Mean	52·424	50·657	52·340	49·672	42·3733	50·473
S.D.	17·278	16·992	15·183	15·594	13·114	16·266

TABLE (xx)

Frequency Distribution of 'C' Scores for Class XI Students

Raw Scores	Ages					
	15+	16+	17+	18+	19+	Total
95–99	..	1	1	1	..	3
90–94	..	2	2	..	..	4
85–89	..	1	4	..	..	5
80–84	2	3	1	..	..	6
75–79	3	5	1	2	..	11
70–74	1	3	9	1	..	14
65–69	4	13	14	2	3	36
60–64	4	7	10	4	3	28
55–59	3	14	7	7	3	34
50–54	6	12	9	9	5	41
45–49	5	11	7	9	8	40
40–44	1	12	2	6	2	23
35–39	0	3	1	3	2	9
30–34	1	1	1	2 ..	..	5
25–29	..	1	2	1	1	5
20–24	..	..	..	..	1	1
15–19.	..	..	..	..	..	..
10–14	..	..	3	1	..	4
5–9	1	3	1	4	..	9
0–4	..	4	..	1	..	5
Total	31	96	75	64	28	283
Mean	57·484	53·771	54·200	52·344	50·036	52·654
S.D.	15·457	19·473	18·171	18·862	10·884	18·166

TABLE (xxi)

Frequency Distribution of M Scores of Class VIII Students

Raw Scores	Ages 12+	13+	14+	15+	16+	Total
100–	..	..	..	..	..	..
95–	..	1	..	..	..	1
90–	..	3	..	..	..	3
85–	..	4	1	..	..	5
80–	3	6	5	..	..	14
75–	4	12	5	2	..	23
70–	10	26	11	7	2	56
65–	17	49	19	17	3	105
60–	13	49	25	16	2	105
55–	17	33	26	21	2	99
50–	15	11	18	19	4	67
45–	4	4	11	9	2	30
40–	4	..	2	5	..	11
35–	1	..	..	..	..	1
30–	..	1	..	..	..	1
25–	..	..	..	..	..	..
20–	..	..	..	..	..	..
Total	88	199	123	96	15	521
Mean	65·921	65·342	61·110	63·406	59·000	63·901
S.D.	9·869	9·203	9·436	8·452	8·327	9·423

TABLE (xxii)

Frequency Distribution of 'M' Scores of Class IX Students

Raw Scores	Ages 13+	14+	15+	15+	17+	Total
100–	..	..	..	..	..	..
95–	.	..	..	..	..	..
90–	..	..	..	..	..	..
85–	..	1	..	..	..	1
80–	2	2	..	.	..	4
75–	..	1	..	1	2	4
70–	2	6	1	..	2	11
65–	1	7	2	2	..	12
60–	9	29	3	4	1	37
55–	11	24	9	4	2	50
50–	9	27	14	11	7	68
45–	14	28	15	13	8	78
40–	5	27	25	17	13	87
35–	9	31	18	17	1	76
30–	7	9	20	6	6	48
25–	..	5	5	1	2	13
20–	..	2	7	1	..	10
Total	69	190	119	77	44	499
Mean	50·044	48·974	46·870	44·857	46·430	47·760
S.D.	11·765	12·006	10·660	9·882	11·881	11·469

TABLE (xxiii)

Frequency Distribution of 'M' Scores of Class X Students

Raw Scores	Ages					
	14+	15+	16+	17+	18+	Total
100–	..	..	..	..	..	..
95–	..	..	1	..	..	1
90–	..	..	..	..	..	..
85–	1	..	2	..	..	3
80–	..	1	1	..	..	2
75–	4	2	3	..	..	9
70–	3	8	5	1	..	17
65–	8	8	12	2	..	30
60–	10	24	11	1	..	46
55–	12	17	23	5	4	61
50–	11	14	15	8	4	52
45–	1	17	15	6	7	46
40–	2	7	8	10	4	31
35–	5	6	3	12	5	31
30–	2	2	2	8	3	17
25–	..	2	1	4	1	8
20–	..	..	..	1	2	3
Total	59	108	102	58	30	357
Mean	57·678	55·241	51·510	48·121	42·833	52·378
S.D.	11·943	11·125	12·056	11·044	9·840	12·170

TABLE (xxiv)

Frequency Distribution of 'M' Scores for Class XI Students

Raw Scores	Ages					
	15+	16+	17+	18+	19+	Total
100–104	.	.	.	..	..	..
95–99	..	..	..	..	..	..
90–94	..	..	.	1	..	1
85–89	.	1	..	..	..	1
80–84	..	4	2	..	..	6
75–79	2	4	..	2	..	8
70–74	5	13	3	3	..	24
65–69	3	12	5	3	2	25
60–64	2	16	7	3	5	33
55–59	6	12	7	3	4	33
50–54	3	5	14	11	5	38
45–49	1	12	8	12	5	38
40–44	6	9	8	6	4	33
35–39	3	5	13	4	..	25
30–34	..	1	5	3	1	10
25–29	..	1	3	1	1	6
20–24	..	..	..	1	..	1
15–19	..	..	..	..	1	1
Total	31	96	75	53	28	283
Mean	59·001	58·771	54·470	50 962	50·393	55·075
S.D.	12·894	12·950	12·616	13·565	11·577	13·214

Appendix—IV

RATES AND ANGLES OF GROWTH

TABLE (xxv)

Growth of Verbal Ability

Level of Brightness	First Year Growth Angle	First Year Growth Rate	Second Year Growth Angle	Second Year Growth Rate	Third Year Growth Angle	Third Year Growth Rate
I	0°	0 0 Score	50°	7·0 Score	19°	1·7 Score
II	27°	2 9 Score	41°	5·4 Score	25°	2·6 Score
III	41°	5·4 Score	49°	6·5 Score	50°	5·0 Score
IV	54°	8·3 Score	41°	5·1 Score	25°	2·7 Score
V	50°	6·9 Score	35°	4·1 Score	60°	9·5 Score

TABLE (xxvi)

Growth of Spatial Ability

Level of Brightness	First Year Growth Angle	First Year Growth Rate	Second Year Growth Angle	Second Year Growth Rate	Third Year Growth Angle	Third Year Growth Rate
I	11°	1·6	40°	4·6	8°	0·8
II	-10°	-1·1	46°	5·4	40°	3·8
III	8°	0·8	41°	4 9	38°	4·1
IV	-5°	-0·2	41°	4·9	33°	2·1
V	11°	1·6	0°	0·0	35°	3·1

TABLE (xxvii)

Growth of Clerical Ability

Level of Brightness	First Year Growth Angle	First Year Growth Rate	Second Year Growth Angle	Second Year Growth Rate	Third Year Growth Angle	Third Year Growth Rate
I	40°	5·1	38°	4·8	40°	5·1
II	40°	5·1	35°	4·6	29°	3·1
III	55°	8·0	50°	7·0	19°	1·9
IV	53°	7·5	50°	6·9	25°	2·6
V	40°	5·1	1°	0·6	54°	7·6

TABLE (xxviii)

Growth of Mechanical Ability

Level of Brightness	First Year		Second Year		Third Year	
	Growth Angle	Growth Rate	Growth Angle	Growth Rate	Growth Angle	Growth Rate
I	—71°	—15·9	34°	7·6	10°	1·3
II	—67°	—16·4	30°	6·3	17°	3·5
III	—78°	—14·2	20°	4 6	15°	3·0
IV	—60°	—18·5	16°	3·3	15°	2·8
V	—82°	—12·6	—16°	—8·6	34°	7·6

TABLE (xxix)

Growth of Reasoning Ability

Level of Brightness	First Year		Second Year		Third Year	
	Growth Angle	Growth Rate	Growth Angle	Growth Rate	Growth Angle	Growth Rate
I	—10°	—1·4	18°	2·3	0°	0 4
II	0°	+0·4	11°	1·6	10°	1·4
III	0°	—0·1	27°	3·6	12°	1·8
IV	16°	2·0	30°	4·3	—2°	—0·5
V	45°	7·9	19°	2·5	20°	2·8

TABLE (xxx)

Growth of Numerical Ability

Level of Brightness	First Year		Second Year		Third Year	
	Growth Angle	Growth Rate	Growth Angle	Growth Rate	Growth Angle	Growth Rate
I	23°	1·7	24°	1·8	33°	2·9
II	2°	0·4	20°	1·5	46°	6·8
III	33°	2·9	19°	1·3	40°	4·1
IV	20°	1·4	26°	2·1	37°	3·5
V	26°	2·1	—16°	—1·0	40°	5·5

TABLE (xxxi)

Growth of Abilities for the Modal Age Group

Abilities	*Growth*					
	First Year		*Second Year*		*Third Year*	
	Growth Angle	*Growth Rate*	*Growth Angle*	*Growth Rate*	*Growth Angle*	*Growth Rate*
V		2·21		4·19		2·08
R		0·73		2·85		2·47
N		2·10		2·79		6·79
S		—0·90		4·16		2·94
C		2·90		2·70		1·82
M		—12·60		5·17		2·72

Appendix V

CORRELATION MATRICES

The product moment 'r's were calculated for each age-cum-grade group, by using the diagonal method. The computational checks were employed at all stages. The mean 'r's were computed with the aid of R A. Fisher's z-function since individual r's varied widely. The significance of the r's at 5% level was determined with the help of Statistical Tables of R. A. Fisher and F. Yates The correlation matrices for each grade cum-age-groups are given below:

FIRST LEVEL OF BRIGHTNESS

Correlation Matrix: Class VIII/Age 12+(N=88)

	V	R	N	S	C	M	Mean 'r'
V	..	·6075*	·1620	·3210*	·2357*	·4045*	·35
R	·6075*	..	·1124	·3065*	·2164*	·3493*	·34
N	.1620	.1124	...	.2371*	.0613	.1463	.14
S	·3210*	·3065*	·2371*	..	·2781*	·3461*	·30
C	·2357*	·2165*	·6013	·2781*	..	·1280	·19
M	·4045*	·3493	·1463	·3461*	·1280	..	·28

Correlation Matrix: Class IX/Age 13+(N=69)

	V	R	N	S	C	M	Mean 'r'
V	..	·3548*	·2598*	·0141	·3320*	·3618*	·26
R	·3548	..	·4970*	·2187	·3420*	·4007*	·36
N	·2508	·4970	..	·2419*	·4520*	·2182	·34
S	·0141	·2187	·2419	..	·2071	·3815*	·22
C	·3320	·3420	·4520	·2071	..	·2052	·31
M	·3618	·4007	·2182	·3815	·2052	..	·32

Correlation Matrix: Class X/Age 14+(N=59)

	V	R	N	S	C	M	Mean 'r'
V	..	·4229*	·2201	·1936	·1030	·1948	·23
R	·4220	..	·3894*	·3102*	·1546	·3664*	·33
N	·2201	·3894	..	·1722	·2100	·4183*	·28
S	·1936	·3102	·1722	..	·0979	·3469*	·23
C	·1030	·1546	·2100	·0979	..	·0383	·12
M	·1948	·3664	·4183	·3469	·0383	..	·27

Correlation Matrix: Class XI/Age 15+(N=31)

	V	*R*	*N*	*S*	*C*	*M*	*Mean 'r'*
V	..	·3960*	·0121	·0265	·0442	·3231	·16
R	·3960*	..	·1165	·1706	·0828	·1474	·19
N	—·0121	·1163	..	·1643	·3567*	·0976	·15
S	·0265	·1706	·1643	..	·3208	·4511*	·23
C	·0442	·0828	·3567*	·3208	..	·3320	·23
M	·3231	·1474	·0976	·4511	·3320	..	·27

*—Significant Correlation at 5% level.

SECOND LEVEL OF BRIGHTNESS

Correlation Matrix: Class VIII/Age 13+ (N=199)

	V	*R*	*N*	*S*	*C*	*M*	*Mean 'r'*
V	..	·5157*	·3578*	·3358*	·2209*	·3978*	·37
R	·5157*	..	·3222*	·3200*	·3527*	·3275*	·37
N	·3578*	·3222*	..	·3565*	·2493*	·3128*	·32
S	·3358*	·3200*	·3565*	..	·2178*	·5043*	·35
C	·2209*	·3527*	·2493*	·2178*	..	·1667*	·24
M	·3978*	·3275*	·3128*	·5043*	·1667*	..	·34

Correlation Matrix: Class IX/Age 14+ (N=190)

	V	*R*	*N*	*S*	*C*	*M*	*Mean 'r'*
V	..	·5770*	·4664*	·1898*	·3244*	·4150*	·40
R	·5770	..	·3468*	·1909	·3580*	·2259*	·35
N	·4664	·3468	..	·2876*	·3764*	·4281*	·39
S	·1898	·1909	·2876	..	·2532*	·3013*	·24
C	·3244	·3580	·3764	·2532	..	·4037*	·34
M	·4150	·2259	·4281	·3013	·4037	..	·35

Correlation Matrix: Class X/Age 15+ (N=1?8)

	V	*R*	*N*	*S*	*C*	*M*	*Mean 'r'*
V	..	·2998*	·2567*	·0967	·0933	·1274	·18
R	·2998	..	·2361*	·0818	·0865	·1761	·18
N	·2567	·2361	..	·2659*	·1168	·4404*	·27
S	·0967	·0318	·2659	..	·2555*	·2608*	·20
C	·0933	·0865	·1168	·2555	..	·1063	·14
M	·1274	·1761	·4404	·2608	·1063	..	·23

Correlation Matrix: Class XI/Age 16+(N=96)

	V	R	N	S	C	M	Mean' r '
V	..	·3210*	·3238*	·1393	·0672	·2556*	·23
R	·3210*	..	·2144*	·1806	·2869*	·1396	·23
N	·3238*	·2144*	..	·4533*	·3722*	·4396*	·36
S	·1393	·1806	·4533*	..	·2769*	·5138*	·32
C	·0672	·2869*	·3722*	·2769*	..	·2437*	·25
M	·2556*	·1396	·4396*	·5138*	·2437*	..	·33

*—Significant Correlation at 5% level.

THIRD LEVEL OF BRIGHTNESS

Correlation Matrix: Class VIII/Age 14+ (N=123)

	V	R	N	S	C	M	Mean' r '
V	..	·3764*	·2457*	·3781*	·1998*	·4343*	·33
R	·3764*	..	·2597*	·2364*	·1492	·3847*	·30
N	·2457*	·2597*	..	·1604	·1517	·3015*	·23
S	·3781*	·2364*	·1604	..	·1420	·4759*	·28
C	·1998*	·1492	·1517	·1420	..	·2435*	·18
M	·3847*	·3847*	·3015	·4759*	·2435*	..	·37

Correlation Matrix: Class IX/Age 15+ (N=115)

	V	R	N	S	C	M	Mean'r '
V	..	·3789*	·2295*	·1336	·1639	·1289	·21
R	·3789	..	·1794	·1467	·0957	·1225	·19
N	·2293	·1794	..	·2669*	·3585*	·2276*	·25
S	·1336	·1467	·2669*	..	·1622	·3180*	·21
C.	·1639	·0957	·3585*	·1622	..	·1828*	·20
M	·1289	·1223	·2276*	·3180*	·1828*	..	·20

Correlation Matrix: Class X/Age 16+ (N=1[illegible]2)

	V	R	N	S	C	M	Mean' r '
V	..	·2266*	·0645	·0114	·0486	·1268	·10
R	·2266*	..	·1607	·1057	·2077*	·0819	·16
N	·0645	·1607	..	·2834*	·1648	·2858*	·19
S	·0114	·1037	·2834*	..	·3194*	·4597*	·24
C	·0486	·2077*	·1648	·3194*	..	·1518	·18
M	·1268	·0319	·2858*	·4597*	·1518	..	·23

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

Correlation Matrix: Class XI/Age 17+ (N=75)

	V	R	N	S	C	M	Mean 'r'
V	..	·3176*	·2942*	·2899*	·1599	·4081*	·30
R	·3176*	..	·1913	·2261*	·0981	·3346*	·24
N	·2942*	·1913	..	·3848*	·2383*	·3978*	·30
S	·2899*	·2261*	·3346*	..	·3064*	·5764*	·36
C	1599*	·0981	·2383*	·3064*	..	·3016*	·23
M	·4081*	·3546*	·3978*	·5764*	·3016*	..	41

*—Significant Correlation at 5% level.

FOURTH LEVEL OF BRIGHTNESS

Correlation Matrix: Class VIII/Age 15+(N=96)

	V	R	N	S	C	M	Mean 'r'
V	..	·5322*	·2219*	·0219	·0394	·1607	·21
R	·5322*	..	·3067*	·0717	·0593	·2547*	·25
N	·2219*	·3067*	..	·1272	·1247	·2816*	·21
S	·0219	·0717	·1272		·1543	·2463*	·13
C	·0394	·0593	·1247	·1543	..	·2582*	·13
M	·1607	·2547*	·2816*	·2463*	·2582*	..	·24

Correlation Matrix: Class IX/Age 16+(N=77)

	V	R	N	S	C	M	Mean 'r'
V	..	·4467*	·2897*	·2752*	·2019	·1677	·28
R	·4467*	..	·0448	·2284*	·3240*	·2037	·25
N	·2897*	·0448	..	·2865*	·1625*	·2177	·20
S	·2752*	·2284*	·2865*	..	·2311*	·3651*	·28
C	·2019	·3240*	·1625*	·2311*	..	·0199	·19
M	·1677	·2037	·2177	·3651*	·0199	..	·20

Correlation Matrix: Class X/Age 17+(N=58)

	V	R	N	S	C	M	Mean 'r'
V	..	·2996*	·0864	·0841	·0980	·0753	·13
R	·2996*	..	·0748	·0994	·0812	·1617	·14
N	·0864	·0748	..	·1780	·0188	·1144	·09
S	·0841	·0994	·1780	..	·3045*	·4891*	·24
C	·0980	·0812	·0188	·3045*	..	·0177	·11
M	·0573	·1617	·1144	·4891*	·4891*	..	·20

Correlation Matrix: Class XI/Age 18 (N=53)

	V	*R*	*N*	*S*	*C*	*M*	*Mean' r'*
V	..	·3005*	·0180	·2011	·0074	·1910	·15
R	·3005*	..	·3088*	·3079*	·1337	·3228*	·27
N	·0180	·3088*	..	·3565*	·1610	·2448	·22
S	·2011	·3079*	·3565*	..	·2324	·4584*	·32
C	·0074	·1337	·1610	·2324	..	·2199	·15
M	·1910	·3228*	·2448	·4584*	·2199	..	·29

*—Significant Correlation at 5% level.

FIFTH LEVEL OF BRIGHTNESS

Correlation Matrix: Class VIII/Age 16+ (N=15)

	V	*R*	*N*	*S*	*C*	*M*	*Mean' r'*
V	..	·5825*	·1950	—·0158	—·1477	·5262*	·25
R	·5825*	..	·3734	—·1845	—·3618	·1454	·13
N	·1950	·3734	..	—·3741	·1737	—·3849	—·006
S	—·0158	—·1845	—·3741		0423	—·0729	—·12
C	—·1477	—·3618	·1737	·0423	..	—·1064	—·09
M	·5262*	·1454	—·3849	—·0729	—·1064	..	·03

Correlation Matrix: Class IX/Age 17 (N=44)

	V	*R*	*N*	*S*	*C*	*M*	*Mean' r'*
V	..	·9323*	·0004	·0697	·2479	—·0818	·36
R	·9323*	..	·2257	—·0096	·2296	·0693	·41
N	·0004	·2257	..	·2725	·0698	·2220	·16
S	·0697	—·0096	·2725	..	·1134	·4099*	·18
C	·2479	·2296	·0698	·1134	..	·0935	·15
M	—·0818	·0693	·2220	·4099*	·0935	..	·15

Correlation Matrix: Class X/Age 18 (N=30)

	V	*R*	*N*	*S*	*C*	*M*	*Mean' r'*
V	..	·2787	—·0317	—·1087	·1340	·2613	·11
R	·2787	..	·2671	·0156	·4320*	·2698	·26
N	—·0317	·2671	..	·0423	·3929*	—·0337	·13
S	—·1087	·0156	·0423	..	·4599*	·2779	·15
C	·1340	·4320*	·3929*	·4599*	..	·4989*	·39
M	·2613	·2696	—·0337	·2779	·4989*	..	·26

Correlation Matrix: Class XI/Age 19 (N=23)

	V	*R*	*N*	*S*	*C*	*M*	*Mean' r '*
V	..	·3534	·2310	·4637*	—·0288	·4603*	·30
R	·3534	..	·1751	·3076	·9045	·6120*	·32
N	·2310	·1751	..	·0664	·1907	·0564	·15
S	·4637*	·3076	·0664	..	·2648	·5131*	·33
C	—·0288	·0945	·1907	·2648	..	·0175	·11
M	·4603*	·6120*	·0564*	·5131*	·0175	..	·35

*—Significant Correlation at 5% level.

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Predictors of School Adaptability

Piloo Buch

In this study the author tries to identify those characteristics of Principals which contribute to the innovativeness of the school, and also attempts to develop an equation to predict school adaptability.

The recognition of the role of the school to bring about educational change goes back to the years in the early fifties when the All India Council for Secondary Education was established and activities directly affecting the school programmes were sponsored by that body. The concept of bringing about change in school got crystalized in 1963 when the NCERT started the programme of intensive school improvement. In the year 1966, the Education Commission (1964-66) reiterated the role of the school and the classroom when it stated, " The destiny of India is now being shaped in her classrooms ". This should naturally place the school in a key position to bring about educational change.

A number of extension centres established by NCERT in different States try to infuse new ideas in school systems. But the installation of these new ideas depends greatly on the adaptability *i.e.*, the tendency of a school to adopt new ideas.

Educational research conducted at Teachers College, Columbia University in early thirties concluded that cost per pupil is the best predic or of adaptability. Mort and others (1938) were trying to show the impact of local control and local initiative in financial terms over the adaptability of schools. The Pennsylvania study reported a correlation of ·587 between educational expenditure and the quality of schools. Along with Mort, Vincent (1945), Wollant (1949), Brickell (1953), Teresa (1955), Campbell (1956), Furno (1956) and Ross (1957) from their different studies arrived at the same conclusion that among the great variety of factors related to innovativeness *i.e.*, adaptability of the schools, the best single predictor of this dimension is educational expenditure per pupil.

On the other hand, Carlson (1965) from his study of Alleghany County and West Virginia schools found that the only powerful factor

in the adoption of educational innovations is the Superintendent of the school. He concluded at the end of his study that expenditure level is not a powerful predictor of the amount of acceptance of new educational practices.

Miles (1965) commenting on the different studies by Mort (1938), Rogers (1962), Carlson (1965), Gallaher (1965), etc., suggested that the organizational dynamics should be the focus of attention in any study on adoption of innovations. Other researchers like Bhola (1965), Hughes (1965), Bennet (1968), Laverne (1968) and Roosa (1969) have also indicated the need to recognize the physical, social and intellectual environments in studying the innovations.

Carlson (1965) has studied such factors as characteristics of Superintendents, their habits of communication, their position in the social structure and characteristics of innovations. Under these broad categories he has selected twenty-five different variables. Marion (1966) has mainly studied a few of the psychological traits of Superintendents and their relation with innovativeness. Both these studies have used multiple correlation and regression analysis for prediction. The studies by Rao (1967) and Bhogle (1969) are the only Indian studies related to adoption of educational innovations or a few psychological traits of principals and teachers. The school should be the unit in the study of innovativeness has been thus clearly brought out by various studies so far. Within the school, the principal is the key factor influencing the school adaptability.

Though a considerable amount of work has already been done in India in the area of diffusion process and characteristics of innovations, the school adaptability and the administrator's role in promoting the same have not been studied to any extent. It may be noted that except one or two, most of the investigators have studied only a few factors at a time. Hence, the need for having a multivariate study aiming at finding out the relationship between the different characteristics of the principal and school adaptability has prompted the present inquiry.

Objectives

(1) To find out whether there are certain important characteristics of the principal which contribute to the innovativeness of the school.

(2) To attempt to develop a prediction equation to predict school adaptability from the knowledge of principal's perceptions, attitudes, professional experiences, etc.

METHOD AND PROCEDURE

The study employs the descriptive—survey—correlational design having a cluster of independent variables and one dependent variable *viz.*, school adaptability.

Sample

The population of the study covers all the high schools of Gujarat. This population consists of 1,700 high schools belonging to different types of management: private aided and government and, schools located in rural and urban areas of Gujarat State. Out of this population, a stratified sample of seventy schools has been taken. The criteria for stratification were the nature of school management and the location of school. Based upon this sample of schools, the corresponding seventy principals became the respondents. Besides this, a random sample of 500 teachers belonging to these schools were also picked up in order to know their perceptions about their schools and their principals.

Tools

In order to measure the dependent and independent variables, following tools were used:

(i) School Adaptability Scale (Buch).
(ii) A Quasi Scale to Measure Independent Variables.
(iii) A Modified Version of Organizational Climate Descriptive Questionnaire (MOCDQ).

(i) *School Adaptability Scale*: This scale was standardized by the investigator herself keeping in view the local conditions. After item analysis the scale included items related to nineteen innovations prevalent in schools of Gujarat. To each item in scale, responses were proposed to be collected against the questions—(i) whether introduced, (ii) partially or fully, (iii) year of introduction, and (iv) continued or not. The test-retest reliability co-efficients of the scale was established as ·86 with forty schools of Gujarat. This scale was validated against an external criterion indicating two groups of schools—adaptable and non-adaptable.

(ii) *Quasi-Scale to Measure Independent Variables*: This scale having ninety-four items was prepared to measure forty-nine different variables which were thought to have some relationship with the dependent variable *viz.*, school adaptability. These forty-nine variables could be categorized into seven different categories *viz.*, (i) demographic,

(ii) institutional, (iii) communication behaviour, (iv) psychological, (v) community, (vi) organizational climate and (vii) miscellaneous. Sufficient care was taken for the preparation and inclusion of items into the scale. The test-retest reliability happens to be .81.

(iii) *Modified Version of Organizational Climate Descriptive Questionnaire (MOCDQ)*: The Halpin and Croft's Organisational Climate Descriptive Questionnaire was modified with respect to the format of the questionnaire as well as content of some of the items. The MOCDQ has the reliability co-efficient of ·83.

Data Collection

The above three tools were administered to the principals as well as to the teachers described in the sample. The data were scored and subjected to statistical treatment to fulfil the objectives and test the hypotheses.

Results

With the help of a Quasi Scale forty-nine independent variables were measured.

TABLE 1

Independent Variables with their M, SD, Values and Correlation Coefficients with the Dependent Variable

Variable No.	*Name of the variable*	*r with Dependent Variable*	*M*	*SD*
1	Age of the principal	·085	27·68	8·48
2	Educational level of the principal	·103	4·06	1·12
3	Inservice Training	.328	5.48	2.80
4	Experience in the profession	·178	4·34	1·52
5	Experience as a principal	·046	2·74	1·45
6	Duration of service in the same school	·083	2·21	1·28
7	Role satisfaction	·125	17·31	4·30
8	Feeling of security	·305	14·05	3·55
9	Self-rated administrative ability	·325	16·51	4·30
10	Perceived peer-rating of administrative ability	·366	15·8	6·26
11	Perceived inspector-rating of administrative ability	·339	16·92	3·92
12	Perceived training college personnel rating of administrative ability	·394	12·27	2·98

TABLE 1—(*continued*)

Variable No.	*Name of the variable*	*r with Dependent Variable*	*M*	*SD*
13	Perceived teachers' rating of administrative ability	·361	17·2	3·37
14	Reported performance feed-back from district inspector of schools	·199	12·16	2·80
15	Reported performance feed-back from the training college personnel	·258	12·47	3·29
16	Perceived change orientation from the district inspector of schools	·202	15·36	3·69
17	Perceived change orientation from the training college personnel	·274	15·76	4·28
18	Perceived equalitarian relationship with district inspector of schools	·183	7·28	2·10
19	Perceived equalitarian relationship with the training college personnel	·336	8·27	2·97
20	Perceived district inspector of schools' support of innovation	·279	4·50	0·97
21	Perceived training college personnels' support of innovation	·409	4·46	0·72
22	Perceived teachers' support of innovation	·094	4·40	0·81
23	General mass media exposure	—·048	6·39	1·87
24	Number of non-professional journals read regularly	·054	2·16	1·06
25	Number of educational journals read regularly	·102	2·77	1·47
26	Frequency of professional meetings attended	·413	3·64	1·26
27	Number of organizational membership	·295	3·63	1·48
28	Inter-school visitation	·495	9·86	3·35
29	Cosmopolite orientation	·334	13·18	2·56
30	Need for autonomy	·048	8·97	1·38
31	Principal's perception of the ability of the training college personnel to provide expert guidance	·483	10·17	2·20
32	Educational level of the community	·095	2·80	0·95
33	Community involvement in school	·317	6·5	3·00
34	Parents' involvement in school	·447	10·22	3·12
35	Type of the community where the school is located	·076	1·71	0·51
36	Size of the school	—·061	4·6	1·26
37	Interest of the management	·314	12·06	2·85

TABLE

Correlation Matrix (16 × 16)

Order of entry	Variables	1	11	3	4	14	[illegible]
1	Inter-school visitation	1·00	·044	·329	·308	·114	[illegible]
11	Self-rated administrative ability		1·00	·013	·096	·114	[illegible]
3	Parents' involvement			1·00	·153	·051	[illegible]
4	Professional meetings attended				1·00	·203	[illegible]
14	Feeling of security					1·00	[illegible]
5	Teachers' college support of innovation						1·00
6	Teachers' college personnel's rating of administrative ability						
7	DIS rating of administrative ability						
12	Community involvement						
8	Equalitarian relationship with teachers' college personnel						
13	Interest of the management						
10	Inservice training						
9	Cosmopolite orientation						
2	Principal's perception of the teachers' college personnel to provide expert guidance						
15	DIS support of innovation						
16	School Adaptability (Criterion variable)						

TABLE 1—(*continued*)

Variable No.	*Name of the variable*	*r with Dependent Variable*	*M*	*SD*
38	Distance of the training college in the city from the school	·283	1·37	1·26
39	Distance of the training college outside the city from the school	—·269	13·4	11·4
40	Disengagement	·0852	1·74	0·48
41	Hindrance	·064	2·05	0·63
42	Esprit	·149	2·88	0·71
43	Intimacy	·149	2·12	0·59
44	Aloofness	—·073	2·25	0·54
45	Production emphasis	·250	2·74	0·70
46	Thrust	·273	2·85	0·72
47	Consideration	·298	2·60	0·68
48	Age of the teachers	—·029	38·80	8·80
49	Experience of the teachers	—·117	10·35	3·82

Since it was very difficult to carry on multiple regression analysis with forty-nine independent variables, it was decided to select a few potential predictors of adaptability. The criteria of selection were: (i) the correlation co-efficients between the independent variables and the dependent variable should be higher, (ii) the correlation co-efficients amongst the independent variables should be low, and (iii) the selected variables should be further screened for the nature of their measurements and the educational value. This led to the selection of fifteen independent variables *viz.*, (i) inter-school visitation, (ii) principal's perception of the ability of the training college personnel to provide expert guidance, (iii) parents' involvement, (iv) professional meetings attended, (v) training college support of innovation, (vi) perceived teachers' rating of administrative ability, (vii) perceived district inspector of schools' rating of administrative ability, (viii) equalitarian relationship with the training college personnel, (ix) cosmopolite orientation, (x) in-service training, (xi) perceived self-rated administrative ability, (xii) community involvement in school, (xiii) interest of the management, (xiv) feeling of security, and (xv) perceived district inspector of schools' support of innovation. The correlation matrix for the above fifteen independent and the dependent variable of the school adaptability along with mean and standard deviation values of the variables is given in Table 2.

Based upon the correlation matrix (vide Table 2), the multiple correlations and multiple linear regression equations with stepwise least square method were calculated. The results of multiple correlations with corresponding F-values are given in Table 3:

TABLE 3

Stepwise Results of Regression Analysis

Order of entry	*Variable*	*Computed R*	*df*	*F-values*
1	Inter-school visitation	0·4958	1,68	66·88
11	Self-rated administrative ability	0·6054	1,67	18·61
3	Parents' involvement	0·6688	1,66	12·63
4	Professional meetings attended	0·7065	1,65	8·34
14	Feeling of security	0·7277	1,64	4·99
5	Training college support of innovation	0·7342	1,63	1·54
6	Teachers' rating of administrative ability	0·7399	1,62	1·35
7	District inspector of schools rating of administrative ability	0·7444	1,61	1·09
12	Community involvement	0·7483	1,60	0·91
8	Equalitarian relationship with training college personnel	0·7519	1,59	0·87
13	Interest of the management	0·7531	1,58	0·27
10	Inservice training	0·7534	1,57	0·08
9	Cosmopolite orientation	0·7536	1,56	0·03
2	Principal's perception of the ability of the training college personnel to provide expert guidance	0·7536	1,55	0·01
15	DIS support of innovation	0·7536	1,54	0·00

It is seen from Table 3 that the correlation between inter-school visitation and school adaptability is ·4958. The multiple R between the variables *viz.*, inter-school visitation and self-rated administrative ability taken together and school adaptability is ·6054. The increase in multiple R is from, ·4958 to ·6054. This increase in R is significant as seen from the value of F which is 18·61 with df 1,67. After the first thirteen variables have been added step by step, the multiple R reaches the maximum value *viz.*, ·7536. The addition of two more variables *viz.*, (i) principal's perception of the ability of the training college personnel to provide expert guidance and (ii) District inspector of schools' support of inno-

vation, does not increase multiple R. The cumulative per cent of variance accounted for by thirteen variables comes out to be 56·8 per cent (R^2). Thus, the combination of the first thirteen variables given in Table 3 appears to provide the maximum predication power. A perusal of the F-values, however, indicates that the F-value is significant at ·01 level for the first four variables only. With these four variables the multiple R is ·7065. The addition of the variable number 14, *viz.*, 'Feeling of security' as the fifth variable, increases the R to ·7277 with the F-value of 4·99 significant at ·05 level. Any further addition of a variable increases the multiple R only slightly as indicated by the subsequent values of F which are not significant. Considering purely statistically, it can be concluded that the five best predictors of school adaptability are (i) inter-school visitation, (ii) perceived self-rated administrative ability, (iii) parents' involvement in the school, (iv) professional meetings attended and (v) feeling of security. In terms of economy also, it can be concluded that the above five variables constitute the best predictors of the school adaptability. However, academic considerations should have an additional say in interpreting the results of a statistical analysis. The present researcher is of the opinion that even though the addition of further variables after the first five does not yield adequate increase in the multiple R, multiple R does increase appreciably though not significantly upto the addition of six more variables. Thus, for the first eleven variables the multiple R is ·7531. Any further addition increases R only in the fourth decimal place and consequently can be dropped. These additional variables are: (i) training college support of innovation, (ii) teachers rating of administrative ability, (iii) district inspector of schools' rating of administrative ability, (iv) community involvement, (v) equalitarian relationship with training college personnel, and (vi) interest of management. This analysis thus identifies eleven predictors of school adaptability for about 57 per cent of the variance in the criterion variable. If the first five variables are taken together they account for 53 per cent of the variance, in the criterion variable. The addition of six variables increases the total accountable variance in the criterion variable by four per cent. These additional variables are academically important and it is thought desirable to retain them. The further analysis provided not only the multiple R and F-values but also the regression co-efficients and also the value of the constant needed for developing the regression equation. Table 4 gives these values upto eleven variables.

TABLE 4

Multiple R, Regression Co-efficients and the Alpha Values

	Name of the variable	Multiple R	Alpha	Regression co-efficients 1	2	3	4	5	6	7	8	9	10	11
X_1	Inter-school visitation	0·4958	5·82	0·85										
X_2	Self-rated administrative ability	0·6054	—9·17	0·88	0·89									
X_3	Patents' involvement in school	0·6688	—13·00	0·73	0·92	0·48								
X_4	Professional meetings attended	0·7065	—15·41	0·60	0·85	0·47	1·35							
X_5	Feeling of security	0·7277	—23·94	0·58	0·80	0·47	1·17	0·72						
X_6	Training college support of innovations	0·7342	—25·12	0·53	0·82	0·43	1·11	0·65	0·78					
X_7	Teachers' rating of administrative ability	0·7399	—25·36	0·56	1·00	0·43	1·16	0·68	1·05	—0·31				
X_8	District inspector of schools' rating of administrative ability	0·7444	—26·00	0·57	0·90	0·38	1·13	0·65	1·16	—0·37	0·22			
X_9	Community involvement in school	0·7483	—26·78	0·57	0·89	0·31	1·11	0·69	1·24	—0·45	0·23	0·32		
X_{10}	Equalitarian relationship with training college personnel	0·7519	—26·83	0·58	0·92	0·30	1·27	0·72	1·65	—0·51	0·26	0·33	—0·35	
X_{11}	Interest of the management	0·7531	—26·77	0·60	0·95	0·31	1·27	0·77	1·67	—0·51	0·25	0·34	—0·35	—0·12

From Table 4 the following regression equations have been developed:

First regression equation with only five variables (R=·7277)

$$\bar{Y} = \cdot 58X_1 + 80X_2 + 47X_3 + 1\cdot 17X_4 + \cdot 72X_5 - 23\cdot 94$$

where: X_1, X_2, X_3, X_4, X_5 stand for predictor variables given in Table 4 above. $\bar{Y}$ predicted score on school adaptability.

Second regression equation with eleven variables (R=·7531)

$$\bar{Y} = \cdot 60X_1 + \cdot 95X_2 + \cdot 31X_3 + 1\cdot 27X_4 + \cdot 77X_5 + 1\cdot 67X_6 - \cdot 51X_7 + \cdot 25X_8 + \cdot 34X_9 - \cdot 35X_{10} - \cdot 12X_{11} - 26\cdot 77$$

where: predictor variables are represented by X_1 to X_{11}. Details may be seen from Table 4 above. $\bar{Y}$ stands for predicted scores on school adaptability.

Discussion

The findings of the multiple regression analysis have been represented by taking five and eleven variables which are helpful in predicting school adaptability. If these variables are scrutinized carefully, they can be classified into four specific categories:

A. Exposure to new ideas:

(i) inter-school visitation;
(ii) professional meetings attended;
(iii) equalitarian relationship with training college personnel.

B. Administrative ability:

(i) self-rated administrative ability;
(ii) teachers' rating of administrative ability;
(iii) district inspector of schools' rating of administrative ability.

C. Positive reinforcement from authorities:

(i) training college support of innovation;
(ii) interest of the management;
(iii) feeling of security.

D. Community involvement in school:

(i) parents' involvement in school;
(ii) community involvement in school.

These are the same categories under which factors related to adaptability were classified on the basis of the correlational study. Carlson (1965) also undertook a regression analysis study where some of the predictors identified by him have been: (i) professionalism, (ii) council membership, (iii) cosmopoliteness, (iv) friendship choice received etc. Carlson's study has yielded a multiple R of ·88 with fifteen variables in Allegheny County schools and multiple R of ·943 with six variables in West Virginia schools. Wallace (1970) studied variables affecting installation of innovations and obtained a multiple R of ·3709 with twenty-eight different variables (ten related to teacher morale, twelve to teacher personality and remaining six to organizational climate in schools). In India, whatever the degree of innovativeness that has developed in schools, it is mainly due to the planned efforts of the Extension Services Departments of the colleges of education and the activities of the various departments of the National Council of Educational Research and Training. It is significant that inter-school visitation, professional meetings attended, equalitarian relationships with training college personnel and training college support of innovations have come out as some of the predictors of adaptability. Cosmopolite orientation has been found to bear a positive relationship with school adaptability though this variable has not come out as a significant predictor in this regression study. This is perhaps because of its having fairly high correlation with inter-school visitation and number of professional meetings attended.

In conformity with the findings of Rogers *et al* (1966), perceived administrative ability whether by self or by district inspector of schools or by teachers has come out as a significant predictor of school adaptability. This factor will play an increasing role in India in school improvement with the development of better programmes in administrative training. This is a neglected area in teacher education programme. The training programme developed by Institutes of Management provides good models from which a training programme for school administrators can gain much.

The community support and parents' involvement are gradually increasing in India as far as school education is concerned. Even though one cannot say that community as a whole has started taking interest in matters like curricula, instruction etc., one finds a growing awareness on the part of parents and the community about the need for improving school education.

The regression equations developed in the present study are the first of their type in India. Such studies will need replication to establish the validity of these equations. Once such cross validity studies are replicated and confirmed, it becomes easier for the administrators and planners to locate and identify innovative schools which would help in introduction and implementation of innovations in schools in future.

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Research on Teacher's Verbal Communicative Behaviour in Classrooms

M. R. Santhanam

The author reviews the researches made in this area, and explains how the various investigations had a consistently practical orientation—the objectives being judging teacher competence and developing strategies of effective teaching.

Research on teaching behaviour is becoming increasingly significant in the context of attempts at developing theories of teaching.

Teaching as a criterion is conceived as a complex framework of reference. The antecedent variables are several. Attempts to study the problem with teaching behaviour as the criterion variable are confronted with the enormity of the task chiefly owing to the multi-dimensionality of the criterion, and the multiplicity of the antecedent variables.

When teaching behaviour is sought to be associated with specified dimensions of expected learning outcomes, similar is the nature of difficulties encountered. In this type of research linking teaching behaviour as the independent variable and learning outcomes as the criterion the need for promoting experimental research seeking to identify causal relationships is even more felt than in research of the former type where it could meaningfully seek to establish at best correlational aspects.

Historical Perspective

Attempts to correlate teacher characteristics with measures of pupil learning could not lead to the establishment of any unequivocal relationships between the variables concerned. There had been in general two

approaches to the problem of linking teacher characteristics with some measures of teaching success. The first was to relate judgements about some personality traits like sympathy, sense of humour etc., to success in teaching while the second sought to correlate biographical and test data like age, sex, I.Q., etc., to some measures of teaching success. Mostly, the criteria of success were supervisor's ratings. Hence, much of the early research concentrated on the construction and validation of rating scales of various types. Studies linking personality traits and other characteristics to measures of teaching success proved to be inconclusive and in some cases contradictory (Barr 1948). The failure to arrive at satisfactorily conclusive relationships between some presage factors relating to the teacher and measures of pupil gain led to the research attention to be increasingly focussed on the process phenomenon itself-namely, the study of teacher classroom behaviour as a phenomenon of possible measurement potential leading ultimately to efficiency assessment.

When the teacher classroom behaviour became the major research framework the verbal communicative behaviour between the teacher and the students naturally demanded the attention of both theorists and researchers since it was believed that the verbal interchange could be reliably indicative of and consistently consonant with non-verbal gestures in the classroom (Flanders 1960).

The scientific study of classroom verbal communicative behaviour which is believed to have begun in the United States in the early 1900's assumed remarkable dimensions of research interest under the impetus of post-war measurement movement, in 1920's and 1930's.

The investigations consistently had a practical orientation the primary objective being judging teacher competence in order to somehow discriminate between good teaching and bad teaching.

Affective and Cognitive Domains

Out of the early and pioneering studies emerged by about mid-century two discernible directions of inquiry both of which concentrated on verbal behaviour in the classroom. The first direction of inquiry emphasised the study of the emotional climate in the classroom through an analysis of the interaction between the teacher and students. This research operated within essentially a socio-psychological framework using terms descriptive of the patterns of the emotional ecology of the classroom teaching-learning situation generated by authoritarian or

democratic attitude of the teacher. The studies by Lewin, Lippit and White (1939), Anderson (1939), Withall (1949) and Flanders (1960) represent some of the significant efforts to analyse and understand teaching behaviour as a prelude to evolving strategies for effective and purposeful teaching.

The second line of research endeavour has been mostly concerned with the cognitive dimension of classroom discussion with a few exceptions of multi-dimensional approach. In design, the cognitive dimension research sought to analyse the cognitive process in the classroom discourse whereas the former socio-emotional climate approach laid emphasis on the probe of the process of group dynamics in operation in the classroom teaching-learning situation. The works of Smith and his associates (Smith 1961; Smith and Meux 1962; Smith 1963; Smith *et al.*, 1964; and Meux and Smith 1964); Bellack and his associates (1963, 1965, 1966); Kliebard (1966 a, b); Aschner and Gallagher and their associates (Aschner *et al.*, 1965; Gallagher and Aschner 1963); and Taba and her associates (Taba, Hilda and Freeman F. Elzey 1964; Taba Hilda *et al.*, 1964) fall in the realm of cognitive approach.

Studies as those of Anderson (1939), Lippitt and White (1939), Withall (1949) and Flanders (1965) served to highlight the prevalence of distinctly contrasting climates in the classroom. Alongside, there have been studies like those of Cantor (1951), Flanders (1951), Perkins (1950) and many others which emphasised the need for a conducive climate for effective learning and called for a type of classroom behaviour on the part of the teacher as would nurture such a climate. The increasing evidence emanating from the several studies which sought to probe the classroom processes as affective enterprise underscored the crucial role of classroom interaction between the teacher and the pupils as also amongst the pupils themselves and served to point out how the classroom behaviour of the teacher plays a significantly decisive role therein. The research findings relating to the prevalence of two contrasting climates and the empirical evidence relating to positive association between a conducive classroom climate and pupil learning prompted researchers to undertake studies leading to the exploration of interaction process and teacher behaviour in the classroom and the identification of several variables affecting what came to be described as teacher effectiveness. Such attempts as those of Amidon *et al* (1967), Pankratz (1967), Flandesr (1963), Morrison (1966), Buch and Santhanam (1971) and many others may be cited in the context.

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

Research linking presage to process variables concerns itself with comparing some aspect(s) of the teaching process with something that existed before the teaching process started. Efforts in this direction can be perceived from two angles: (i) those studies which discuss relationships between teacher traits like for example teacher personality or teacher perception measures and some process variables of teaching behaviour and, (ii) those studies involving some kind of training experience of pre-service or inservice teachers and process variables.

Buch and Santhanam (1971) exploring the role of sex of the teacher as factor of teacher classroom behaviour found that male and female teachers differed significantly in respect of (i) their capacity to generate student talk, (ii) their questioning ratio and (iii) their content emphasis.

There have been some attempts at linking teacher classroom behaviour with the curricular subject taught. Buch and Santhanam (1970) studied the predominant patterns of classroom behaviour of teachers teaching English while the same authors (1972) studied teacher's initiation-response balance in different subject matter areas.

Some studies are reported which sought to administer inservice and pre-service programmes involving the use of interaction analysis technique with the objective of modifying teacher behaviour. The work of Flanders (1963), (1964), Storlie (1967), Moskovitz (1967), Zahn (1967), Kirk (1967), Hough and Amidon (1967), Furst (1967), Hough and Richard (1967), Lohman *et al* (1967), Hough (1967) and Zahorik (1968) provide evidence to support the thesis that training in interaction analysis has a decisive effect on the modification of teacher behaviour.

The ultimate need for developing strategies of effective teaching is highlighted by the work of Santhanam (1971) who sought to develop some means of augmenting ' creative inquiry ' in the classroom.

In the cognitive dimension approach, Smith and his associates developed two conceptual units of analysis, the episode and the monologue. The resultant classification of entries according to their logical character resulted in 13 items—namely, defining, describing, designating, stating, reporting, substituting, evaluating, opening, classifying, comparing and contrasting, conditional inferring, explaining and directing and managing classroom. Later were developed by Smith and his associates (1964) the two new units of discourse: the venture and the strategy. The work of Smith and his associates although complex and as yet incomplete is a major effort to develop a descriptive framework for analysing teaching.

Bellack and his associates developed a multi-dimensional framework, providing for four basic verbal manoeuvres, called pedagogical moves, namely, Structuring, Soliciting, Responding, and Reacting.

The system developed by Aschner and Gallagher followed closely Guilford's primary categories of intellectual operations (Guilford 1959). Cognitive memory, convergent thinking, divergent thinking, evaluative thinking, and routine. Taba's coding system is based on three hierarchical cognitive tasks; grouping and labelling (with nine sub-categories); interpreting and making inferences (with 11 sub-categories); and predicting consequences (with ten sub-categories). The teacher's attempt to lift to cognitive discourse from one level to a higher one is the focus of attention. It is contended that with specific training, the teacher can help children make the transition from only concrete operations to more complex formal operations.

In general, the cognitive dimension studies of Smith, Bellack, Aschner and Gallagher and Taba concentrate on verbal manifestations of cognitive process whereas the climate studies have a different focus, namely, the emerging social-emotional climatic equilibrium. Apart from a difference in focus there is difference again in sampling procedure. While cognitive studies employ conceptual units, the climate studies use units of time as a way of sampling the verbal behaviour.

Indian Scene

Research in teaching behaviour has been taken up in India in right earnest as is evidenced by the pioneering efforts under the direction of Dr. M. B. Buch, in the All-India Centre of Advanced Study in Education at Baroda (Santhanam, 1972). The message is spreading and perceptibly greater interest is shown in undertaking research in this vital area of inquiry.

The aim of research on teacher behaviour should help an educator to devise ways and means of modifying teacher behaviour. If this is to be achieved it is necessary that inquiries are undertaken about the correlates of teacher behaviour. Contemporary research into verbal communicative behaviour emphasises developing a theoretical context for the research rather than prematurely emphasising the establishment of relationships between classroom variables and outcome variables. A premature concern with immediate identification of good and poor teachers or efficient and inefficient teaching behaviour is relatively shunned. Some of the more recently developed systems of classroom

observation hold promise of helping to create some ordered understanding out of the complex and seemingly haphazard events that make up a typical classroom.

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Estimation of School Enrolment, Teachers Required and Direct Recurring Expenditure for Maharashtra

B. B. Yeole

In this paper the author has attempted to estimate the primary and secondary enrolments by grades and sex, the required number of teachers and, the direct recurring expenditure upto 1981.

The urgency for expanding as well as improving education in India can not be overstated. In order to bring about expansion and improvement in education, it is of the utmost necessity to have information about the number of future primary and secondary school enrolments by grades and sex as well as the required number of teachers. For national planning of education it is also essential to have an estimate about the recurring expenditure. Hence, in this paper, an attempt is made to estimate the future enrolment for primary and secondary school-going population, the required number of teachers and the expenditure in Maharashtra, one of the major states of India. The estimations have been made upto 1981. It is hoped that the type of information provided in this paper would be useful for planners and policy-makers in the educational field. Before going any further it must be stated that the inadequency of the data (especially non-availability of age grade statistics) necessitated certain assumptions in the methodology for carrying out the estimations.

Prior to the formation of Maharashtra State (which came into existance in 1960), the three principal regions of Maharashtra, *viz.*, Western

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Maharashtra, Vidharbha and Marathwada belonged to different States and as such showed considerable imbalances in educational development. One of the major problems which government faced was to secure an all-round expansion of educational facilities in all parts of the State and to reduce as quickly as possible, the regional imbalances in educational development.

It is a matter of great satisfaction that this responsibility has been discharged creditably, in spite of the handicaps created by the backlog of underdevelopment in Vidharbha and Marathwada, Maharashtra is now reckoned as one of the ' Educationally advanced States of India.'[1]

Pre-primary Education

Though the importance of pre-primary education in the scheme of General Education has always been recognised, expansion in this sphere had to be left to private enterprise because it has not been possible even till now, to fulfill the constitutional directive of free and compulsory primary education upto the age of 14. It is seen that pre-primary education in Maharashtra is still in its infancy. Even in 1965-66 the State had only 448 pre-primary schools with an enrolment of 33,860 and spent only-one-third of one per cent of its total educational expenditure on this sector. Due to non-availability of data estimation of enrolments, teachers required and recurring cost for pre-primary education has been ignored.

Primary Education

In Western Maharashtra, compulsory primary education was introduced in 1947-48 in all areas with a population of 1,000 and above according to the 1951 Census. Compulsory primary education in Vidarbha was introduced by Primary Education Act of 1950 and the amended Act of 1956 of the former M. P. Government. In Marathwada, the Hyderabad Compulsory Primary Education Act of 1952 was enforced in 1953 in all the villages covered by the Community Development projects and in a block of 20 contiguous villages in each district of Hyderabad State.

In Western Maharashtra and Vidarbha the primary course was and continues to be of 7 years duration. In Marathwada there used to be an infant class followed by a primary course of 4 years, classes V to VII were considered to be secondary. In 1963, the pattern of classes in

[1]Government of Maharashtra, Education Department, Report of Educational Development in Maharashtra State, 1968, p. 1.

Marathwada was changed by naming the Infant class as class I and renumbering the further classes consecutively. For estimating the enrolments for primary education a course of 7 years' duration (*i.e.*, Grades 1 to 7) has been assumed for all the three regions of Maharashtra.

The general progress of primary education in Maharashtra during the period 1950-51 to 1965-66 is given in Table 1.

TABLE 1

Progress of Primary Education in Maharashtra (1950-51 to 1965-66)

Item	*1950–51*	*1955–56*	*1960–61*	*1965–66*
Institutions	22,423	28,741	34,864	42,092
Enrolment (in 000s)				
Classes I-IV	2,186	2,679	3,533	4,552
Classes V-VII	481	588	973	1,540
Total	2,667	3,267	4,506	6,092
Teachers	74,161	90,738	1,14,610	1,54,795
Total direct expenditure (Rs. in crores)	7·59	10·69	16·30	26·75

Source: Report of educational development in Maharashtra State, p. 15, Education Department, Government of Maharashtra, Bombay, 1968.

It is observed that the progress in primary education in Maharashtra is satisfactory. During the period 1950-51 to 1965-66 the number of primary schools had increased from 22,423 to 42,092 or at the average annual rate of 4·3 per cent. The total enrolment in classes I-VII had increased from 26·67 lakhs to 60·92 lakhs or at an average annual rate of 5·6 per cent. The total number of teachers had increased from 74,161 to 1,54,795 or at an average increase of 5 per cent per year. The total direct expenditure increased from Rs. 7·59 crores to Rs. 26·75 crores or at an average rate of 8·7 per cent per year.

Secondary education

Secondary education in Maharashtra is mainly provided at the initiative of voluntary agencies subsidized by Government on a grant-in-aid basis. In Western Maharashtra and Vidarbha the majority of the secondary schools are managed by voluntary organizations. In Marathwada, however, a majority of them were government schools.

After the establishments of Zilla Parishads on 1st May 1962, all the government schools from all the three regions were transferred to Zilla Parishads.

The duration of secondary education varies from region to region. In Western Maharashtra it covers five years: Classes VIII-XI in High Schools followed by one year of the Pre-University course which is conducted in colleges. In Vidarbha it covers four years: Classes VIII-XI in the Higher Secondary Schools or Classes VIII-X in High Schools followed by one year of the Pre-University Course in colleges. In Marathwada, the duration of the course is four years: Classes IX-XII (new) in the Higher Secondary schools or classes IX-XI in high schools followed by one year of the Pre-University Course in colleges. For estimating the enrolments for secondary education 4 years duration course (*i.e.*, Grades 8-11) has been assumed for all three regions of Maharashtra.

The general progress of secondary education during the period 1950-51 to 1965-66 is given in Table 2.

TABLE 2

Progress of Secondary Education in Maharashtra (1950–51 to 1965–66)

Items	*1950–51*	*1955–56*	*1960–61*	*1965–66*
Institutions	765	1,018	2,198	3,721
Enrolment in Class VIII-XII (in 000s)	244	298	528	941
Teachers	13,377	18,195	33,100	55,244
Total direct expenditure (in crores)	3·29	4·85	9·63	17·76

Source: Report of educational development in Maharashtra State, p. 33, Education Department, Govt. of Maharashtra, Bombay, 1968.

It is seen that secondary education in Maharashtra has shown satisfactory progress in all directions during the period 1950-51 to 1961-66. In fact, its growth has been faster than that of primary education. The number of institutions has increased from 765 in 1950-51 to 3,721 in 1965-66 or at an average annual rate of 11·1 per cent. The enrolments at the secondary stage have increased, during the same period from 2·44 lakhs to 9·41 lakhs or at an average annual increase of 9·4 per cent. The total number of teachers in secondary schools has increased from 13,327 in 1950-51 to 55,244 in 1965-66 or at an average annual rate of 9·9 per

cent. The total expenditure on secondary education increased from 3·29 crores in 1950-51 to Rs. 17·76 crores in 1965-66 or at an average annual increase of 11·9 per cent.

ESTIMATION OF ENROLMENTS BY GRADES AND SEX

(i) *Primary Education*:

The population of primary school age which roughly corresponds to the age range 6-12 years has been estimated by using the interpolation formula:[2]

$$P_{6-12}=0{\cdot}728P_{5-9}+0{\cdot}784\,P_{10-14}-0{\cdot}112\,P_{15-19}$$

where P_{5-9}, P_{10-14} and P_{15-19} are the populations aged 5-9, 10-14 and 15-19 respectively.

The population aged 5-9, 10-14 and 15-19 given in Table 3 are taken from the estimates given in population projections for Maharashtra State prepared by Kulkarni[3] which corresponds to the declining fertility and no migration assumption.

TABLE 3

Population in quinary ages between 5–19 by sex, Maharashtra 1966–81 (in thousands)

Sex	*Age group*	*1966*	*1971*	*1976*	*1981*
Male	5– 9	3,157	3,637	3,933	4,341
	10–14	2,662	3,115	3,598	3,899
	15–19	2,234	2,624	3,079	3,570
Female	5– 9	2,984	3,415	3,687	4,053
	10–14	2,526	2,934	3,369	3,648
	15–19	2,056	2,481	2,892	3,330

In addition to the above figures, if single year of age data and geographic distribution or rural/urban distribution of the population

[2]Yeole, B. B. & (Miss.) Saraswathy, P. R.: On estimating the school age population for compulsory education in some ECAFE countries. *Indian Educational Review*, Vol. 7, No. 1, Jan. 1972, p. 117.

[3]Kulkarni, A. V.: Population Projections for Maharashtra State, 1961-81, submitted to the DTRC (Now known as IIPS) as a part of the training programme, June 1962.

were available, it would have been better for estimation of school population as the school populations are quite different in their participation by geographic or other areal units. Unfortunately we do not have such detailed data and so estimation is made only for the Maharashtra State as a whole, and as such will be only approximate and of limited value.

Enrolment data by sex in the various grades of the primary schools of Maharashtra is available for the years 1961-65 and is given in Table 4.

TABLE 4

Enrolment in primary schools by sex and grade, 1951-65

Sex	*Grade*	*1961*	*1962*	*1963*	*1964*	*1965*
Male	P_1	9,21,236	9,12,285	8,54,655	8,72,880	9,55,000
	P_2	5,50,546	5,85,981	6,86,513	6,76,684	6,64,539
	P_3	4,64,121	4,74,396	5,44,805	5,98,458	5,87,022
	P_4	4,01,659	4,28,173	4,45,274	4,93,173	5,28,766
	P_5	3,16,728	3,45,791	3,77,762	4,01,035	4,39,055
	P_6	2,53,587	2,73,041	3,00,519	3,26,910	3,48,030
	P_7	2,00,608	2,21,186	2,38,105	2,61,945	2,83,481
Female	P_1	6,64,718	6,49,886	6,23,458	6,56,428	7,45,000
	P_2	3,25,176	3,46,480	4,23,878	4,31,804	4,44,149
	P_3	2,44,556	2,56,408	2,99,075	3,41,108	3,45,309
	P_4	1,94,979	2,12,101	2,25,404	2,54,983	2,82,116
	P_5	1,30,159	1,46,114	1,64,150	1,81,790	2,03,334
	P_6	97,572	1,08,409	1,23,099	1,36,624	1,51,185
	P_7	74,736	84,638	93,400	1,04,670	1,15,188

Source: Report of Educational Development in Maharashtra State, pp. 22-23, Education Dept., Govt. of Maharashtra, Bombay, 1968.

We do not have adequate data on drop-outs and repeaters, but we can work out some approximate ratios concerning the percentage of pupils remaining in elementary schools after one, two, . . . years from the data of Table 4.

From the above table we note that there were 9,21,236 boys enrolled in grade 1 (P_1) in 1961. Next year in 1962 we find only 5,85,981 boys are enrolled in grade 2(P_2). There is an apparent loss of 3,35,255 boys from the cohort which entered P_1 in 1961. Possibly many of the boys in the cohort had not dropped out of the school altogether, but simply failed to progress to grade P_2 and were repeating grade P_1 in 1962. On the other hand possibly not all the boys in grade P_2 in 1962 had come from the grade P_1 cohort of 1961, because some of these might also have been in grade P_2 already in 1961. In the absence of actual data on the number of repeaters by grade each year we can only assume that the two sets of repeaters were approximately equal in number, hence the percentage ratio between grade P_2 enrolment in 1962 and grade P_1 in 1961 would represent an approximate retention ratio for grade P_2 cohort of 1961.

On a similar basis, the approximate retention ratios for both the sexes for each of the grade cohorts beginning in 1961 to 1964 are given in Table 5.

From Table 5 it seems that the retention ratios for boys are slightly better than those for girls.

TABLE 5

Approximate grade retention ratios in all primary schools by sex and grade

Sex	*grade year*	Approximate retention ratios between grades					
		P_1 *to* P_2	P_2 *to* P_3	P_3 *to* P_4	P_4 *to* P_5	P_5 *to* P_6	P_6 *to* P_7
Male	1961	0·636	0·862	0·923	0·861	0·862	0·872
	1962	0·753	0·930	0·939	0·882	0·869	0·872
	1963	0·792	0·872	0·905	0·901	0·865	0·872
	1964	0·761	0·867	0·884	0·890	0·868	0·867
Female	1961	0·521	0·739	0·867	0·749	0·832	0·867
	1962	0·652	0·863	0·879	0·774	0 842	0·862
	1963	0·693	0·804	0·853	0·807	0·832	0·850
	1964	0·677	0·800	0·827	0·797	0·832	0·845

Another assumption that has to be made that concerns the percentage of pupils repeating the final year of the primary school. With not

enough information for guidance on this point an allowance, will be made for 10% grade P_7 pupils to fail in grade 7 of which only 50% will remain in the elementary school after their failure in grade P_7. It shall further be assumed that these repeaters in grade 7 would be automatically promoted in the next year.

Now before the grade retention ratio method is applied we would estimate an intake into the primary school stage. For this purpose we shall define the intake ratio at grade 1 of primary school will be estimated as: Ratio of number of pupils in grade 1 to the number of children of primary school age (6-12 years), from the data for the period 1961-1965 using the number of pupils by sex in grade 1 given in Table 4, whereas the population aged 6-12 years estimated by sex by the formula given earlier in Table 3.

Thus the intake ratios come out to be:

Year	*Males*	*Females*
1961	25·96	19·96
1962	24·94	18·89
1963	22·66	17·53
1964	22·44	17·86
1965	23·82	19·63

The estimated population aged 6-12 years which may be considered to be of primary school age for the period 1966-81 can be obtained from Table 3 by the application of a three point interpolation formula in conjunction with the formula given earlier for getting the 6-12 years age segment. These figures multiplied by the intake ratios at grade 1 will give the grade 1 enrolment figures for the respective periods.

We see that intake ratios have fluctuated for both the sexes. For boys we can take an average for these 5 years as the approximate value for future intake ratio as it is at the maximum level. Thus the intake ratio for boys is taken to be as 23·97. For girls, in 1966 the intake ratio has been assumed as an average of last five years which is equal to 18·77. After 1966 we have assumed an intake ratio each year of 1 per cent higher than the year before. Under these assumptions the population aged 6-12 years and the enrolment in grade 1 during 1966-81 by single year are given in Table 6.

TABLE 6

Estimated primary school population aged 6–12 years and elementary grade I enrolment, Maharashtra, 1966–81 (in thousands)

Year	Males		Females	
	Population 6–12 years	Enrolment in EI	Population 6–12 years	Enrolment in EI
1966	4135	991	3922	770
1967	4260	1021	4033	802
1968	4388	1052	4147	835
1969	4521	1084	4264	869
1970	4655	1116	4384	904
1971	4796	1150	4508	941
1972	4900	1175	4603	973
1973	5006	1200	4700	1003
1974	5115	1226	4799	1038
1975	5226	1253	4900	1072
1976	5339	1280	5002	1107
1977	5431	1301	5087	1138
1978	5525	1324	5173	1171
1979	5621	1347	5260	1203
1980	5718	1371	5349	1239
1981	5817	1394	5438	1271

We see from Table 5 that the retention ratios have fluctuated between almost all grades for each cohort and for both the sexes. Combining the experience of all four cohorts we arrive at approximate retention ratios as an average for these 4 years between all the grades for both the sexes. In view of above assumption approximate retention ratios work out to be:

Grades	Males	Females
P_1–P_2	·736	·636
P_2–P_3	·883	·814
P_3–P_4	·913	·857
P_4–P_5	·884	·782
P_5–P_6	·866	·835
P_6–P_7	·871	·866

Using these retention ratios in conjunction with the estimated enrolment in grade-1 during 1966-81 by single years as presented in the above Table and gradewise distribution available for 1961-65, the gradewise distribution of population by sex in 1966-81 by single years is obtained and given in Table 7, (see fig. 1 also).

TABLE 7

Gradewise Distribution of Pupils in Primary Education by Sex, Maharashtra, 1966–81 (by single years)

(in thousands)

Years	E_1	E_2	E_3	E_4	E_5	E_6	E_7	*Total*
				Boys				
1966	991	703	586	536	468	380	317	3931
1967	1021	729	621	535	474	405	336	4121
1968	1052	751	644	567	473	410	369	4266
1969	1084	774	663	588	501	410	375	4395
1970	1116	798	683	605	520	434	375	4531
1971	1150	821	705	624	535	450	396	4681
1972	1175	846	725	644	552	463	411	4816
1973	1200	865	747	662	569	478	423	4944
1974	1226	883	764	682	585	493	436	5069
1975	1253	902	780	698	603	507	450	5193
1976	1250	922	796	712	617	522	463	5312
1977	1301	942	814	727	629	534	477	5424
1978	1324	958	832	743	643	545	488	5533
1979	1347	974	846	760	657	557	498	5639
1980	1371	991	860	772	672	470	509	5745
1981	1394	1009	875	785	682	578	520	5843
				Girls				
1966	770	473	361	296	221	170	137	2428
1967	802	490	385	309	231	185	154	2556
1968	835	510	399	330	242	193	167	2676
1969	869	531	415	342	258	202	175	2792
1970	904	553	432	356	267	215	183	2910
1971	941	575	450	370	278	223	195	3032
1972	973	598	468	386	289	232	202	3148
1973	1005	619	487	401	302	241	210	3265
1974	1038	639	504	417	314	252	219	3384
1975	1072	660	520	432	326	262	228	3500
1976	1107	682	537	446	338	272	238	3620
1977	1138	704	555	460	349	282	247	3735
1978	1171	724	573	476	360	291	255	3850
1979	1203	745	590	491	372	301	264	3966
1980	1237	765	606	506	384	311	274	4083
1981	1271	787	623	519	396	321	282	4199

(ii) *Secondary Education*

Enrolment data by sex in the various grades of the secondary schools of Maharashtra is available for the years 1961-65 and is given in Table 8.

TABLE 8

Enrolment in secondary schools by sex and grade, 1961 to 1965

Sex	*Grade*	*Enrolment in*				
		1961	1962	1963	1964	1965
Male	S8	1,62,730	1,81,377	2,02,179	2,18,363	2,41,480
	S9	1,32,085	1,47,523	1,64,687	1,82,642	1,96,419
	S10	1,04,731	1,19,921	1,34,467	1,49,976	1,67,558
	S11	63,149	71,126	83,163	92,428	99,015
Female	S8	51,103	58,962	66,582	73,660	83,228
	S9	40,295	45,514	52,244	58,670	64,912
	S10	30,699	36,044	41,165	47,573	53,838
	S11	19,588	23,201	27,260	30,703	34,104

Source: Report of Educational Development in Maharashtra State, Educational Department, Government of Maharashtra, Bombay, 1968.

From Table 3 and Table 8 the grade retention ratios from grade 7 (P_7) of elementary school systems to the grade 8 (S_8) of the secondary school system during 1961-65 are given in Table 9 for both the sexes. These grade-retention ratios are calculated under the assumption that grade S_8 pupils were all new pupils and that there were no repeaters and that all the new entries in S_8 are just from the previous year cohort from P_7 and not from old cohorts who had left schooling for a period of time after passing P_7 as the repeaters in S_8 and the other new entries are negligible in number.

TABLE 9

Approximate grade retention ratios in all secondary schools by sex and grade

Sex	*Approximate retention ratios between grades*							
				Sex				
Year	$P_7 to S_8$	$S_8 to S_9$	$S_9 to S_{10}$	$S_{10} to S_{11}$	$S_7 to S_8$	$S_8 to S_9$	$S_9 to S_{10}$	$S_{10} to S_{11}$
1961	·904	·907	·908	·679	·787	·891	·895	·749
1962	·914	·908	·911	·693	·787	·886	·904	·765
1963	·917	·903	·911	·687	·789	·881	·911	·746
1964	·922	·900	·917	·660	·795	·881	·911	·717

The grade retention ratios by sex within the secondary school system can be calculated on similar assumptions as for the primary school system and are given in Table 9, based on available data for the period 1961 to 1964.

The retention ratios as calculated here are seen to fluctuate for almost all grades and both the sexes, but the differences are not much. So far for estimating the future enrolment the average for four years for all the grades and both the sexes has been used. The average retention ratios between all the grades and both the sexes has been used. The average retention ratios between all the grades by sex work out to be:

	Males	*Females*
P_7 to S_8	·914	·789
S_8 to S_9	·905	·885
S_9 to S_{10}	·912	·905
S_{10} to S_{11}	·680	·744

It can also be assumed that there will be no repeaters in grade S-11 even though some pupils fail in grade S-11 as they can appear externally for the grade S-11 examination which is conducted by secondary school examination Board.

Based on these assumptions, the estimated number of pupils by sex in secondary schools by grade by single years during 1966-81 is given in Table 10 (see fig. 1 also).

TABLE 10

of pupils in Secondary Education by Sex, ra, 1966–81 (by single years)

(In thousands)

Grade S_9	S_{10}	S_{11}	*Total*
Boys			
218	178	114	781
245	199	121	855
262	223	135	927
278	239	152	1006
305	154	163	1065
310	278	173	1104
310	283	189	1144
328	283	192	1179
340	299	192	1218
350	310	203	1262
361	319	211	1302
372	329	217	1341
383	339	224	1382
395	349	231	1421
404	360	237	1456
412	368	245	1490
Girls			
74	59	40	268
84	67	44	303
96	76	50	344
108	87	57	384
117	98	65	418
122	106	73	445
127	110	79	469
136	115	82	492
141	123	86	516
147	128	92	540
153	133	95	561
159	138	99	584
166	144	103	608
173	150	108	632
178	156	112	654
184	161	116	677

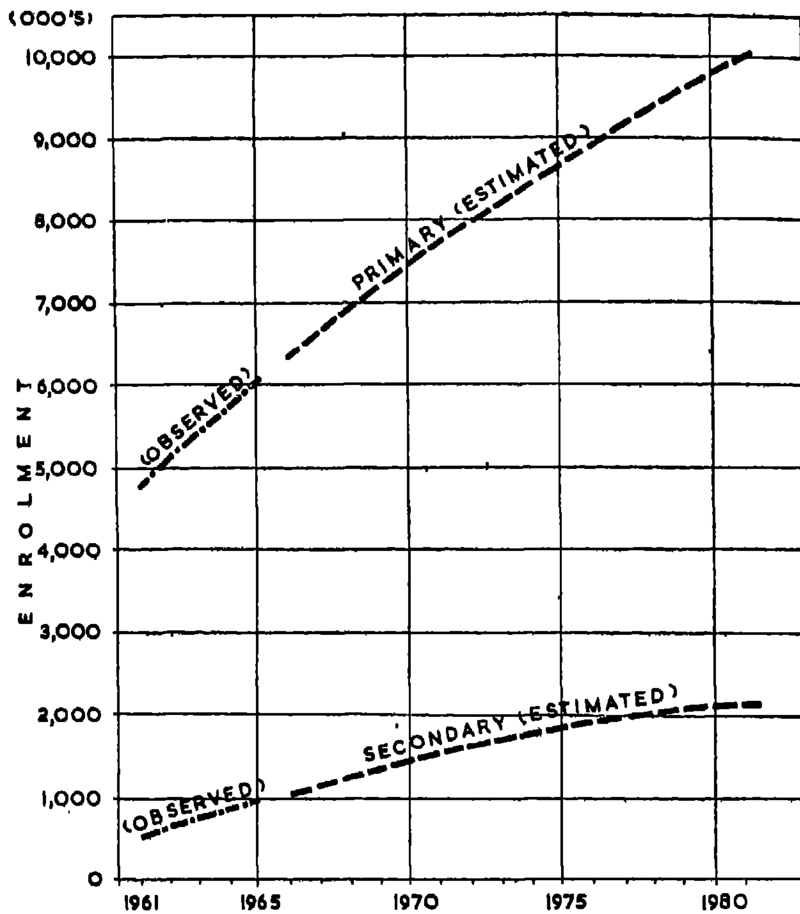

Fig. 1 Maharashtra: Total Enrolment in primary and secondary schools, observed upto 1965, and estimated upto 1981.

Estimation of Number of Teachers

We shall now examine the implications of our enrolment estimates in terms of the number of teachers that will be required to take care of the increasing number of pupils at both the levels of education.

Primary Education

The pupil-teacher ratios at lower primary level have been estimated to be 34 in 1950-51 and 38 in 1965-66 for India by the Education Commission.[4] The pupil-teacher ratio at the lower primary level is proposed to be raised by Education Commission from 38 in 1965-66 to 50 in 1975-76. This is inescapable if a living wage is to be given to the primary teachers. If smaller classes are considered desirable either additional funds will have to be found or the rate of expansion will have to be deliberately slowed down. When the birth rate in India falls down to somewhere between 15-20, it will be easily possible to reduce the class size somewhere between 30-35, at the lower primary level. But smaller classes with the present level of birth rate will be costly and beyond the economic capacity of the country.

The pupil-teacher ratios of higher primary level have been estimated to be 24 in 1950-51 and 31 in 1965-66 for India by Education Commission,[5] the general picture at this stage is similar to that at the lower primary stage. The pupil teacher ratio is proposed to be raised by the Education Commission from 31 to 35 and maintained at this level.

The estimated pupil-teacher ratios at primary level for Maharashtra[6] are 35, 35, 37 and 36 for the years 1950-51, 1955-56, 1960-61 and 1965-66 respectively.

Secondary Education

The pupil-teacher ratios at lower secondary education have been estimated to be 25 for 1950-51 and 1965-66 for India by the Education Commission.[7] The pupil-teacher ratio is proposed to be maintained at this level in the future also by the Education Commission. The pupil-teacher ratios at higher secondary level have been estimated to be 16 for 1950-51 and 15 for 1965-66 by Education Commission.[8] The pupil-teacher ratio has been assumed at 20 after 1965-66 for this level by Education Commission. The estimated pupil-teacher ratios for secondary

[4]Govt. of India, Ministry of Education, Report of the Education Commission, 1964-66, p. 480.

[5]*Ibid.*

[6]Govt. of Maharashtra, Education Dept. op.cit. p. 15.

[7]Govt. of India, Ministry of Education, op.cit. p.505.

[8]*Ibid.*

education for Maharashtra[9] are 23, 24, 25 and 26 for the years 1950-51, 1955-60, 1960-61 and 1965-66 respectively.

In view of the above discussion it is assumed that the average pupil-teacher ratio for all elementary schools could be 40 and that for the secondary schools will be of the order of 25. The estimated number of teachers required for both levels of education has been given in Table 11.

Compared with the present number of teachers this would imply an addition to the primary and secondary teaching staff by about 6,000 and 3,000 teachers respectively at every year. In addition, allowance must be made for additional teachers to replace those leaving the service for such reasons as death, retirement, change of occupation etc.

TABLE 11

Estimated Enrolment (in thousands) and number of teachers required for both the levels of education based on pupil teacher ratios, 1966–1981

Year	Primary education		Secondary education	
	Enrolment	Teachers	Enrolment	Teachers
1966	6409	1,60,225	1049	41,960
1967	6647	1,66,175	1158	46,320
1968	6942	1,73,550	1271	50,840
1969	7187	1,79,675	1390	55,600
1970	7441	1,86,025	1483	59,320
1971	7713	1,92,825	1549	61,960
1972	7964	1,99,100	1613	64,520
1973	8204	2,05,225	1671	66,840
1974	8453	2,11,325	1734	63,360
1975	8693	2,17,325	1802	72,080
1976	8932	2,23,300	1863	74,520
1977	9159	2,28,975	1925	77,000
1978	9383	2,34,575	1990	79,600
1979	9605	2,60,125	2053	81,120
1980	9828	2,45,700	2110	84,400
1981	10042	2,51,050	2167	86,680

[9]Govt. of Maharashtra, Education Development, op.cit. p. 33,

ESTIMATION OF TOTAL DIRECT RECURRING EXPENDITURE

We shall now turn to a consideration of the expenditure per pupil at both the levels of education. This depends mostly upon three factors: The average annual salary of a teacher (*a*); The pupil-teacher ratio (*t*) and the expenditure on all non-teacher costs which can be expressed as a percentage of the average salary of a teacher. Symbolically it can be stated as follows:

$$\text{Cost per pupil} = \frac{a(1+r)}{t}$$

where a = average annual salary of a teacher.
r = ratio of non-teacher costs to teacher's salary.

In India all these factors have undergone changes in each sector during the last 15-20 years with the result that the overall cost per pupil has increased from Rs. 37 in 1950-51 to Rs. 64 in 1965-66. In future also it is expected that these factors will have influence on the resulting expenditure and that there will be an increase in cost per pupil for various levels of education. Keeping in view of all related factors the Education Commission[10] have estimated cost per pupil for India for various levels of education for the 1950-51 to 1985-86 and are given in Table 12.

TABLE 12

Average Annual cost per pupil in Rs. (1950–51 to 1985–86)

Year	*Lower primary*	*Upper primary*	*Lower secondary*	*Higher secondary*
1950–51	20	37	73	..
1965–66	30	45	107	..
1975–76	52	87	203	363
1985–86	80	118	268	444

Source: Report of Education Commission, Ministry of Education, Govt. of India, p. 505, 1966.

[10] Govt. of India, Ministry of Education, op. cit. p. 505.

The estimated average annual cost per pupil (in rupees) for Maharashtra[11] for both the levels of education for the period 1950-51 to 1965-66 are given below:

Year	*Primary education*	*Secondary education*
1950–51	29	106
1955–56	34	112
1960–61	39	117
1965–66	48	122

It is observed that the average annual cost per pupil for primary education has increased from Rs. 29 in 1950-51 to Rs. 48 in 1965-66, which shows that there is a 3·4 per cent increase in the rate of average annual cost per pupil for primary education during 1950-51 to 1965-66. The increase in the rate of annual cost per pupil for secondary education works out to be 0·96 per cent.

In the light of the above discussion the average annual cost per pupil has been estimated for both the level of education. For estimating the average annual cost for the period 1966-81 the increase in the rate of average annual cost per pupil for primary education and secondary education is assumed to be 3·4 per cent and 0·96 per cent respectively. The average annual cost per pupil in 1965 for primary education is assumed to be Rs. 48 and for secondary education it is assumed to be Rs. 122. The total direct expenditure for both the levels of education for each year has been estimated by multiplying the average annual cost per pupil to the corresponding enrolment in that year. (See Table 13).

It is seen from Table 13 that the total direct recurring expenditure will increase from Rs. 31·8 crores in 1966 to Rs. 82·2 crores in 1981 or at an average annual rate of 10·7% for primary education and, from Rs. 12·9 crores in 1966 to 30·8 crores in 1981 or at an average annual rate of 10·6% for secondary education.

[11]Govt. of Maharashtra, Education Dept., op.cit. pp. 15, 33,

TABLE 13

Estimated enrolment (in thousands), average annual cost per pupil in Rs. and total direct recurring expenditure (in thousands) for both the levels of education, 1966-1981.

Year	Primary education			Secondary education		
	Enrolment	*Average annual cost per pupil*	*Direct recurring expenditure*	*Enrolment*	*Average annual cost per pupil*	*Direct recurring expenditure*
1966	6409	49·63	318079	1049	123·17	129205
1967	6647	51·32	341124	1158	124·35	143997
1968	6942	33·06	368343	1271	125·54	159561
1969	7187	54·86	394279	1390	126·75	176183
1970	7441	56·73	422128	1483	127·97	189780
1971	7713	58·66	452445	1549	129·20	200131
1972	7964	60·65	483017	1613	130 44	210400
1973	8209	62·71	514786	1671	131·69	220054
1974	8453	64·84	548093	1734	132·95	250535
1975	8693	67·04	582779	1802	134·22	241864
1976	8932	69·32	619166	1863	135·51	252455
1977	9159	71·68	656517	1925	136·81	263359
1978	9383	74·12	695468	1990	138·12	274859
1979	9605	76·64	736127	2053	139·45	286291
1980	9828	79·25	778869	2110	140·79	297067
1981	10042	81·94	822841	2167	142·14	308017

CONCLUSION

The available statistics do not permit us to estimate technical and higher educational enrolments because of several reasons. Lack of data is one such reason and the problem of comparability of the available data over time because of definitional changes are the others. If more data of the needed type become available it would be worthwhile to estimate those important segments of the school education population as well.

According to the calculations made here, the primary school-going population has shown an increase of more than 56% in the 15 years since 1966, *i.e.*, about 4% per annum. An additional 3·5 million children will

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

have to be accommodated in the next 15 years. The secondary school population is expected to increase by 106% in the next 15 years, *i.e.*, an increase of about 7% per annum. In other words, there will be an increase by about a 1·1 million pupils during the period. The present study indicates that in the next fifteen years 90 thousand and 45 thousand teachers will have to be added to the primary school and secondary school teaching staff, respectively. From the figures estimated in this paper it is seen that the total direct recurring expenditure will increase from Rs. 31·8 crores in 1966 to Rs. 82·2 crores in 1981 for primary education and, from 12·5 crores in 1966 to 30·8 crores in 1981 for secondary education.

The figures given in this paper may be taken as tentative target figures and will have to be revised when more and detailed data become available. But in the immediate future, these figures are anticipated to be of use to the administrators and planners as indicative of the future prospects of this important segment of the population.

Grade retention ratio method as illustrated in this paper has been used often in the estimation of school-going population in the developing countries.[12] This paper aims at utilising the scant data available for the State of Maharashtra and at illustrating its application so that other States and countries may also aim at the collection of the needed data and utilise this cohort approach in the estimation of the school-going population.

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[12]United Nations/UNESCO.: Estimating future school enrolment in developing countries, p. 91, ST/SOA/Ser. A/40, New York.

SUMMARY

The aim of the study is to test the hypotheses that (i) pre-service training for secondary school teachers is not adequate for all time, (ii) colleges of education are the best places for imparting in-service training, (iii) there is need for catching up with the latest trends in teaching school subjects in view of the explosion in knowledge, and (iv) there is need for treating school as a unit by itself. The study also attempts to assess the role of extension services department in the qualitative improvement on secondary education. This is a summary of the study conducted by M. J. V. Gurunadham in 1972.

Editor.

Role of The Extension Services Department in Qualitative Improvement of Education at Secondary Level

The growth of in-service education has been linked up with the growth of pre-service training. Several suggestions were made by different committees and commissions. From the Wood's despatch (1854) to Kothari Commission (1964-66) the importance of the teachers' professional improvement has been stressed. All India Council for Secondary Education was formed in 1955 for studying the problems relating to qualitative improvement of secondary education and it set up Extension Centres in 24 training colleges all over the country to provide in-service programmes for the secondary school teachers. The number of centres and units rose up and, today we have in all 97 institutions of this type spread all over the country.

Method of Investigation: Survey method of descriptive research.

Sample: 400 subjects comprising secondary school teachers, heads of schools, teacher-educators and inspecting officers covering an area of six districts in Andhra Pradesh.

Tools Adopted: 1. Questionnaire.
2. Ranking-Scale.
3. Check-List.

The *questionnaire* was prepared with 107 items on five-point scale under the following four main areas:

1. Adequacy of pre-service training,
2. Agency for in-service education,
3. Need for catching up with the latest trends,
4. Need for treating the school as a unit by itself.

The first main area was again subdivided into five sub-areas, each covering items relating to:

1. classroom instruction,
2. school activities,
3. guidance services for pupils,
4. evaluation, and
5. teacher's professional improvement.

The *Ranking Scale* contained eight factors which are considered responsible for making the extension services effective and the subjects were asked to rank them in order of importance. The factors are:

1. Financial resources of the Extension Services Department.
2. Adequacy of the material resources of the E.S.D.
3. Competency of the human resources of the E.S.D.
4. Co-operation of the school authorities with the E.S.D.
5. Co-operation of the participant-teachers with the E.S.D.
6. Adequacy of the planning of the extension services of the E.S.D.
7. Efficiency of the organisation of the extension services of the E.S.D.
8. Adequacy of the follow-up of the extension services of the E.S.D.

The *Check-List* was constructed with 12 major types of service. rendered by the extension services department, *viz.:*

1. Seminar and group discussions,
2. Workshop,
3. Lectures,
4. A. V. Services,
5. Library services,
6. Assistance in science clubs,
7. Science fairs,
8. Experimental projects,
9. Seminar readings,
10. Demonstration lessons,
11. School visits, and
12. Publications.

Administration: The tools of research were administered to about 400 subjects both personally and by direct mail technique. Out of 400 administered, 216 subjects returned them, thus making the returns 54%. For purposes of statistical treatment the data collected from 200 subjects was taken into consideration to facilitate the computational work.

Findings: From the analysis and interpretation of the results obtained, the following conclusions were drawn:

1. All the subjects have shown a fairly high preference for the role of the extension service department in the qualitative improvement of secondary education.

2. The four hypotheses which have been tested in the study have been found in the following order of favourableness:
   - (i) The college of education as the competent agency for in-service education.
   - (ii) The need for catching up with the latest trends.
   - (iii) The need for treating the school as a unit by itself.
   - (iv) Adequacy of pre-service training.

3. Sex is found to be a highly significant factor in determining the opinions of the groups, particularly, among the B.Ed. assistants and heads of schools, the woman subjects being more favourable than men in their opinion on the role of extension services.

4. The other variables such as age, qualification, designation, service, type of management, locality and participation in extension programmes do not exert such a significant influence on the subjects. However, the type of management, especially under the private sector seems to have a slight influence.

5. Pre-service training appears to be helpful to the secondary school teachers to meet certain professional needs in the order of decreasing adequacy as shown hereunder:
   - (i) Class room instruction.
   - (ii) Evaluation.
   - (iii) Teacher's professional improvement.
   - (iv) School activities.
   - (v) Guidance services for pupils.

6. Sex seems to be a significant factor in determining the opinions of the group on the adequacy of pre-training also, the women subjects regarding it more adequate than the men.

7. On the competence of the colleges of education, age, designation, service and locality seem to exercise a significant influence on the opinions of the group. Evidently, maturity in age and length of service are helpful to the subjects to realise the potentialities of this institution to render in-service education. With regard to designation, teacher-educators seem to have a greater faith in the competence of this institution when compared to the other group. As regards the locality, the group from urban areas seem to be more aware of the competence of this institution than the other group from rural areas and, evidently, the impact of this institution should rise in respect of the group in rural areas.

8. On the need for catching up with the latest trends, the locality of the institution from which the subjects have been taken, seems to have a significant influence—the group coming from the urban area, particularly, the district headquarters, promising a more favourable opinion than the others.

9. The group has favourably supported the hypothesis that each secondary school should be treated as a unit by itself for its qualitative improvement.

10. Co-operation of the school authorities like the headmaster, the inspector and the management with the extension services department is considered most essential for the effectiveness of extension services.

11. The group has given the least importance to the factor relating to the follow-up of extension services. Evidently, the group does not seem to realise the importance of follow-up work, probably on account of its conspicuous absence.

12. Of the given twelve major extension services, 'Seminar and other programmes for group discussions' has received the highest preference by the subjects and the rest are preferred in the following order of importance: demonstration lessons, workshops, A. V. services, Science fairs, library services, experimental projects, assistance in science clubs, school visits, seminar readings, publications and lectures.

13. Even in the preferences for the major types of extension services some differences are revealed among the male and female subjects; women subjects giving their highest preference for demonstration lessons, while the men for seminar and group discussions.

14. School visits, publications and lectures have been preferred least which indicate that they are not developed at present so well as to serve the felt-needs of the schools.

Suggestions for further research: In the light of the research findings obtained, the investigator feels that certain aspects of the problem demand furthor careful and elaborate study:

1. The effect of participation in extension programmes.
2. The impact of locality on extension services in relation to different occupational groups.
3. An exclusive and thorough study on the adequacy of pre-service training, and suggestions for its improvement.
4. A general study on the practical problems of teachers and the felt-needs of the schools.
5. A survey of opinions of teachers and others involved, on various aspects of improving the extension services so as to meet their needs.

BOOK REVIEWS

Sociological Dissection of Urbanites

Beyond the Village : Sociological Explorations

Satish Sabherwal (ed.), Institute of Advanced Studies, Simla, 1972, pp. 269, price Rs. 40.

Four Social Scientists who had entered the profession through studies conducted in the tribal or rural settings, apparently finding their task less than exciting, look beyond the village. This opening out of the inquiries follows two major developments (i) in the subject-matter under study and (ii) in the growth of adequate tools to cope with the new situation. Sabberwal continues to be interested in castes, but looks into the factors behind their mobility, and scans an area where changes really begin *viz.*, the urban one. He brings into bold relief the differential degree of mobility among three castes and suggests how the economic rather than political force provides the initial momentum in one of the groups. At this stage, he moves towards concepts, which in his opinion, would clarify the issues. The reviewer, however, feels that the substantive issue on the primacy of alternative channels—economic and political—has the potential of being gone into through comparative approach, and the material, rich in itself, subjected to this methodological treatment with much greater profit.

Atal takes three types of communities two of which are villages and the third, a district town. Patterns of communications at three levels and among the three units provide initially the explaining factor for differential voting, a relationship that is designed to be explored through techniques of pannel studies along schedules having tests of awareness based on the recent discussions on political articulation. The paper is essentially an evidence of how serious readings and discussions precede the selection of variables, their indicators, chosen with possible lines of analyses built into the tool itself. In terms of the use of techniques and selection of a process operating on the rural setting and the region, the paper breaks a new ground.

Madan enters the urban field near Delhi—and looks at doctors whose background reflects their upper stratum and urban origins. The author tries to look into similarities and differences of doctors in two cities of

differing size, and finds similarities rather than differences as more striking. This brings into focus the degree of urbanity among urban centres of less than 5 lakh population. The paper relies on techniques of intensive study—interviews and observations—and makes use of statements that express qualitative response not merely by stating words used by respondents, but also by indicating how they had put accent on certain words to carry the point home to the investigator. Possibilities in the use of 'encounters' as a concept suggested by Goffman encompassing a good number of social relations in the urban setting are suggested for serious consideration. It is heartening to note that doctor's role is tried to be studied as seen by himself, the parents, and the patients.

Yogendra Singh's study is urban both in contents and design. The role structure of the academicians is discussed in the context of attributes of modernization. University teachers are good examples of inter-generational mobility on both academic and occupational counts. Cognition of modernity is analysed in terms of pattern variables of Parsons and two basic dilemmas (i) affectivity *v.* affective-neutrality and (2) particularism *v.* universalism identified though a full discussion of how these two sets serve the heuristic purpose better than the other three, but what happens to these others would have been enlightening. The priority given to the two dilemmas, however, suggests, inter-alia, the type of Society we have in our country. The author is concerned with the study of what one might call " ways of thinking " of teachers. Objective criteria of commitment have been used in seeing the output of published material, and the selection of criteria has affected, as the author notes, the response of junior teachers who have put in less years of work. The complexity of measuring elements of tradition and modernity has been tried to be faced through a four-fold typology and the greater applicability of two of these categories suggests how the discontinuous model of modernization can be put on the ground for studies.

Beyond the village is a remarkable piece of work. It reflects the coming of age of sociological pursuits in India. Contributors enter new fields of research, spell out the techniques used in greater details than is normally found, state the authorities whose models attract them, but as yet show a sort of hesitancy in striking out explanatory variables of forces that provide historicity to phenomena under review. One hopes that just as this work presents a shake-up in our choice of subjects and techniques of research, another shake-up would come some day, when the innovativeness would extend to conceptualization and theori-

zation. The work presents a model illustration of careful editing, and sets new standards in our country of the minimum qualifications and home-work required of a person who could be called an editor. Participants to the seminar provided insightful comments that would attract notice beyond the authors of the papers on which they had emerged.

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Impact of Education on Social Structure of Villages

Education and Social Change

G. S. Bhatnagar. The Minerva Associates, Calcutta, 1972 pp. 150, Price Rs. 25

The book under review is a comparative study of three villages of Punjab from Ambala District. The author (as he claims) attempts to find out the impact of the 'creative' function of education on the social structure of the villages investigated by him. The first two chapters are devoted to evolving of theoretical and conceptual frameworks and the methodology adopted for the research project. Social and demographic characteristics of the respondents have been discussed in the chapter three. The main concern in the chapters 4, 5, 6 and 7 is the description of the attitudes of the respondents towards various social institutions, such as caste, occupation, marriage and family, political and religious institutions. Social characteristics of the out-migrants have been discussed in the chapter 8. A concluding chapter and an appendix have also been included in the volume. The book is an outcome of the author's doctoral research work.

The objectives of the study are not clearly understandable to the reader. The author states that education affects the cognitive elements in an individual's personality by inculcating some new thought patterns and reshaping the old ones. The author also talks of 'cognitive dissonance' and 'cognitive harmony', 'character structure' and other theoretical propositions. On page 15 the author states that the present study intends to find out the extent of modernization as a result of education. A set of six hypotheses have been stated for the study (p. 16) to understand the extent of attitudinal transformation from traditional to modern. These so-called hypotheses are simple statements which do not propose variable relationship for investigation.

Dr. Bhatnagar has selected 272 respondents from the three villages on the basis of the two major criteria, namely, varying educational facilities and urbanization. The respondents are both illiterate and educated. The educated ones have been grouped into three categories, namely, primary, middle and matriculation or above. On the basis of systematic stratified random sample the respondents were selected for the purpose

of interview. Questions included in the interview schedule were related to background of the respondents, caste system, kinship and joint family, marriage, panchayat and leadership, religion and mechanized agriculture. Besides, the schedule, non-participant observation was also used for data collection. Tests of significance have also been employed.

The book lacks insight and introspection about the relationship between education and social change. Any study of social change cannot be so carefree as to neglect the fundamental element of historicity. As such some basic data must have been gathered and analysed. Dr. Bhatnagar's study becomes superficial because of its emphasis exclusively on attitudes and that too without relating the attitudinal responses to the background data of the villages and its inhabitants. Studies on joint family and caste have concluded that education does not weaken these institutions, rather it strengthens and increases their functionality and adaptability. Some of the questions formulated are extremely vague and unrealistic. On page 40, (Table 1) relationship between a number of institutions, such as joint family, religion, caste and education and 'modern attitudes' has been shown. These institutions as such do not mean anything unless they are specified, the contexts are defined, and again 'modern attitudes' would imply the same extent of confusion. The questions regarding joint family (p. 41) are not issue—specific. The conclusions drawn (p. 33) are again so obvious and non-research-like, for example, the younger people, higher caste men and white collar Job-doers are more educated than the older, low caste persons, and those who are engaged in agriculture, etc.

Dr. Bhatnagar concludes that education brings about changes in interactional patterns which reduce dissonance and restore an attitudinal balance. As a result of education, friendship pattern cuts across caste restrictions and traditional ties. But Dr. Bhatnagar's reference of the pattern variable of duffuseness *v.* specificity to understand this change is not based on proper understanding and the implications of the use of Parsonian framework. The author has used the concepts of 'great' and 'little' traditions without working out their application to his data. According to the author of these concepts flow of the elements of these two traditions involve two processes, namely, universalisation and parochialisation. These terms, that is, 'little', 'great', 'parochialisation', and 'universalisation' are not universally accepted and their utility as concepts is related to processes of change which is being questioned by scholars. Thus, Dr. Bhatnagar's book has certain serious

INDIAN EDUCATIONAL REVIEW
Volume 8, Number 2, July 1973

limitations, some of which perhaps could have been removed by way of avoiding use of certain concepts and through incorporation of basic data.

To sum up, for a proper understanding of impact of education on social structure and personality formation Dr. Bhatnagar's book should have made analysis of some more basic aspects. The other variables which are probably more significant in moulding the attitudes of the people have not been studied or their role has not been assessed or controlled to understand the 'extent' of social change. Attitudinal responses as given by the author cannot explain the changes that have really taken place. Proper assessment of the role of education would have been possible when at different levels of analysis their responses were related to structural elements, situations and background of the respondents. Therefore, such a treatment of social change seems to be quiet unconvincing. The selection of the villages in terms of urbanisation is not satisfactory. One of the three villages is at a distance of just three miles from the other. It is really unrealistic to expect significant differences between these two contiguous villages.

How do we explain the case of an illiterate man who has 'modern attitudes', and that of a literate man who has 'traditional attitudes'. This perhaps could have been done by conducting case studies of some persons living in the villages and those of the out-migrants. Family histories of some families could have been very important source material to evaluate the role of education on social structure. Case studies of those who obtained education above matriculation could have been very insight giving. To lump them with the matriculates would not allow a better understanding. Reducing the investigation to questions inviting responses into 'yes' or 'no' is really deceptive and superfluous. Thus, this study suffers from both methodological and sutantive problems of analysis. However, it is a simple and readable account.

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On Modern Mathematics

New Trends in Mathematics Teaching, Vol. III.*

UNESCO, Paris, 1973

During the last ten to fifteen years very significant changes have taken place in the field of school mathematics. It is often said that a 'revolution in school mathematics' has come about. Today we have what is called "New mathematics" or "Modern Mathematics" as contrasted with what is called "traditional mathematics".

The usefulness of new mathematics is being recognised by all concerned. Today we have more than 100 experimental projects in different parts of the world dealing with new mathematics.

However, new mathematics is not yet a finished product. Educators are constantly thinking about this branch of education, and the idea of new mathematics is getting more and more crystalised. Generally speaking, the experimental projects undertaken by teams of specialists (the teams consisting of mathematicians, curriculum—experts, pedagogists, teachers etc.), develop their own "thinking" on new mathematics depending on several considerations. So we find diversity in the 'thinking' behind the experimental projects.

The UNESCO, whose main function is improvement of education, has taken a lead in dessimination of knowledge concerning new trends. Earlier, it brought out two volumes on *New Trends in Mathematics Teaching*. These two volumes contained prominent articles on the teaching of mathematics collected from standard journals all over the world.

The two volumes contained articles and reports which were in either English or in French (often without a summary in the other language). A reader interested in obtaining an overall picture of the new trends in mathematics teaching could do so only by reading the entire volume and then drawing his own conclusions as to the new trends, which was time-consuming. So a new strategy was adopted for the third volume.

In February 1971, representatives of the International Commission on Mathematics Instruction (ICMI) of the International Mathematics

*Copies are available at: Orient Longmans Ltd., B-3/7, Asaf Ali Road, New Delhi-1.

Union (IMU) and other prominent mathematics educators were invited to Paris to advise UNESCO on its mathematics education programmes, including the preparation of the third volume of "*New Trends in Mathematics Teaching*". A tentative selection was made of the different sub-topics whose trend-analysis was considered useful for inclusion in the third volume. Then, an authoritative individual or a team of individuals was invited for writing each chapter. These papers which analysed world trends in the subject were discussed and finalised in a two-week meeting later.

Thus the third volume of *New Trends in Mathematics Teaching* contains chapters on Primary Mathematics, Algebra, Geometry, Probability and Statistics, Analysis, Logic, Applications of Mathematics, Trends in Methods and Media used in Teaching Mathematics, Evaluation and Research in Mathematical Education followed by Epilogue.

In Primary Mathematics, while the ability to compute satisfactorily in the decimal system of notation remains an important goal, the goals of subsequent study of mathematics at secondary levels and development of mathematical literacy for all children are equally stressed. In most of the new programmes ideas of sets, relations, functions, mappings are introduced informally through diagrams, etc., to unify and clarify concepts. The concept of binary operation on a set S as a mapping $S \times S \longrightarrow S$ is developed not only w.r.t. ordinary addition and multiplication but also with reference to least common multiple, greatest common factor, modular addition, modular multiplication, etc. Elementary ideas of probability and statistics also find a place in primary mathematics. A beginning of Algebra is made with the introduction of true and false sentences, solution sets, etc. Measure is no longer the only geometric instruction; now geometry is viewed as study of space from a number of view points—topological, physical, transformational and simple vectorial aspects. Introduction of transformation geometry in primary mathematics is suggested by many. There are a few experimental projects in which vectors have been introduced at the upper elementary grades. Geometry with rectangular co ordinates is usually limited to metric aspects with the construction of simple graphs and the measuring of distances.

The 'discovery approach' to learning mathematics is emphasised in all new programmes.

A variety of teaching aids (Multibase blocks, Mini computer, etc.) have been developed and are being used in classrooms.

Algebra is no longer a theory of calculation with quantities nor only a solution of equations. The modern concept of Algebra is that it is a study of principal structures. All the important classical Algebra—both concepts and special skills are developed within the frame work of these structures. A modern course in Algebra at secondary level has the following major areas namely,—1. Operations and operational systems; 2. Sets, relations and mappings; 3. Structures and isomorphisms; 4. Constructing number systems; 5. Vector space structure; 6. Applications. In teaching this algebra stress is as much or more, on concepts and properties rather than special skills and methods. This does not mean that essential processes and computational aspects are ignored, but that much of the traditional drill on meaningless calculations should be eliminated.

A lengthy study of Euclidean Synthetic Geometry is disappearing from the modern curriculum although the establishment of an acceptable programme of instruction in geometry is one of the most difficult curriculum problems today. The trend is that the organisation of geometry should move farther and farther away from its traditional isolated scheme into the fold of unified mathematics study. Today geometry must be conceived as the study of spaces. Each geometry is a couple (set, structure) in which the elements of the set are called points and the structure is a set of axioms, including the necessary definitions, which establish relations between points and the important subsets. With this concept, the teaching of geometry comes closer and closer to algebra and it is for this reason that it should be developed in such a manner as to permit and to exhibit the use of algebraic structures and techniques.

Some fifty years ago combinatorial probability was a part of the secondary school curriculum, but because of the few genuine applications it was dropped subsequently. Within the last 20 years, the axiomatic development of the subject and the tremendous growth of its applications in various fields like industry, commercial enterprises, agriculture, meteorology, politics and society, etc., made the subject of probability and statistics reappear in the modern curriculum. The trend is to introduce the concepts of probability right from the primary level. Fundamental ideas such as certainty, uncertainty, outcome, event, relative frequency, etc., are introduced at the primary level. In the middle level through experiments and combinatorial considerations, the first ideas of trial, outcome space and probability are introduced. Also collection and examination of statistical data, simple ideas of measures of central

tendency, measure of dispersion are introduced at the level. The tendency at the secondary level is to develop a rather substantial idea of conditional probability, random variable and expectation with easy applications. In some countries, at the secondary level, the study of distributions and their applications to hypothesis testing is included.

There is world-wide universal trend towards teaching analysis at the secondary school level. There are two somewhat contrary points of view regarding presentation of the subject matter of analysis. One point of view is to get to the applications of the subject as quickly as possible. The other point of view is to know thoroughly what one is doing before actually applying it. The modern tendency in introducing analysis is to first study continuity with the topological ideas of the δ neighbourhood and their use in defining point or uniform continuity. From this it is easy to develop the theory of limits without recourse to sequences and series. Both differentiation and integration then follow in simple fashion. The teaching should terminate with topics such as differential equations which have rich potentiality for applications.

Mathematics and logic have always been intimately related. In the past the only application of logic was the axiomatic development of synthetic geometry. Today, however there are simpler structures on which axiomatic proof and quantification can be applied. Logic need not be a separate study in school, but it should be an integral part of teaching mathematics at several levels first informally and then more formally—developing the connectives, implication, truth values, inference schemes and quantification. While the degree and manner of teaching logic in the schools is not a settled question, undoubtedly its presence will grow in future.

There has been a tremendous increase in the applications of mathematics in different fields and this is being reflected in modern programmes. Linear programming, scale-drawing, surveying, navigation, are some of the new applications of mathematics found in mathematics programmes. A great influence on application of mathematics has been that of the computer. Because of the importance of computer, many school programmes now rightly include the elements of computation—the construction of flow charts and the elements of such languages such as FORTRAN OR ALGOL.

The work of psychologists such as Pieget and Bruner have had a great impact on education during the last decade. As a consequence, personnal activity and involvement of pupils in learning has been increas-

ingly emphasised as fundamental for concept formation, longer learning retention and more readily transfer of learning to new situation. In primary school, " learning by doing " is gaining acceptance in a large number of countries. One of the important goals of mathematics teaching that is being very much emphasised is to enable the individual to attain knowledge and insight by means of independent study. Besides, most modern teaching and learning aids are being manufactured all over the world. We have today appratus like Cuisenaire rods, Stern apparatus, Dienes' multibase arithmetic blocks, Steiner's operational systems, Games on finite algebraic Structures, circuit boards to solve problems of logic, etc., which help the pupils explore and discover mathematical concepts. To help the teachers achieve efficient and more individualised teaching, we have aids such as overhead projectors and transparencies, ready-made lessons on audiotape or radio, etc. In some countries use is being made of desk calculators as a medium for learning mathematics.

In recent times there has been rethinking on the role of evaluation. Evaluation is now considered an integral part of the teaching process rather than an external feature of the educational system. There is greater awareness on the part of evaluators as to what is to be evaluated and how best it could be evaluated. Evaluation is no longer confined only to the cognitive domain. There is increasing emphasis on evaluation of attitudes, etc. The thinking on educational evaluation is being very much influenced by the work of Bloom and his co-workers who produced a general taxonomy of educational objectives.

There is need for further research in mathematics education. The research should be directed towards answering questions such as (*a*) how does one teach mathematics so that it will be useful; (*b*) how do children form mathematical concepts; (*c*) how can the ' value ' and " effectiveness " of a new curriculum for the schools be gauged ? Can they be ? (*d*) what are the major dimensions underlying different methods of instruction? What is the relationship between learning modes and instructional methods? (*e*) what degree of computational skill is essential to all citizens? How can this be attained? etc.

The task of writing trend-analysis in a field like mathematics education where revolutionary changes are taking place is not an easy one. The authors of this book have done this job successfully. This will be a valuable book for those who are working in the field of curriculum planning.

The UNESCO intends to bring out similar volumes on the teaching of mathematics. The following observations may be given due consideration while working on future volumes.

1. In order to understand critically the chapters in this third volume under review, one should have a very sound knowledge of mathematics, particularly of abstract algebra. A vast majority of teachers who are actually teaching mathematics at present do not have this background knowledge. The understanding and co-operation of the teachers is absolutely necessary for any reform to be successful. So, while writing the future volumes the aspect of teacher and his mathematical background may have to be kept in view. This means that explanations should be quite elaborate and so on.
2. In trend analysis, some specific trends are mentioned. In some cases one is not able to make out clearly whether that trend is simply the thinking of an authority in that area or whether it has been experimented upon. The curriculum planner has to feel convinced that a particular idea has been tried out successfully. So it is suggested that as far as possible experimental findings should be given in support of specific trends.
3. By sheer coincidence, all the authors who have contributed to the third volume are from advanced countries. So, it appears that the trend analysis reflects what is happening mostly in advanced countries. The trends in developing countries will be more meaningful (from the practical point of view) for countries which are underdeveloped. In the present context it is the under-developed and developing countries that need the help of UNESCO in the task of curriculum development. Therefore it is suggested that in the subsequent Volumes in the series, the trend analysis is so presented as to reflect what is happening in both developing and developed countries also.

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A New Technique for Adult Education

An Experiment in Functional Literacy Teaching through Naya Savera Method.

R. Shankar, Literacy House, Lucknow, July 1972.

Any research, evaluation and experimentation in the field of Adult Education particularly Functional Literacy is welcome considering the serious inadequacy of such material not only in our country but in other parts of the World. The concept of functional literacy is rather new and translation of this concept into concrete Programmes is really a very difficult job. We have however, to do this; otherwise functional literacy would only be hanging in the air. The Literacy House, Lucknow, has been a pioneering Institution in the field of Adult Literacy and Adult Education and has made valuable contribution in the fields of Training and Orientation of Personnel, Production and Distribution of Materials, Research, Evaluation and experimentation. The publication under review is a useful addition to the list of a large number of publications brought out by the Literacy House.

2. The Thirty-two page Report begins with the forward by Shri E. C. Shaw, Director, Literacy House, Lucknow. There are five chapters (1) Introduction, (2) Method of Study, (3) Findings, (4) Discussion and (5) Summary of the findings and conclusions.

3. Under 'Introduction' one gets an idea of the development of Naya Savera Teaching Techniques, the Testing Phase and the Purpose of the Study. The primary purpose of the study was to compare literacy attainments of two groups of Adult Literacy class participants; one following six months functional literacy syllabus strictly according to the time schedule and the other following the same syllabus in extended period of nine months keeping in view the pace of progress made by the adult participants. This could be done by (*a*) finding out the literacy attainment levels of adults participating in the classes conducted for 6 months, strictly following the programme break-up and time schedule, (*b*) finding out the literacy attainment levels of adults participating in the classes conducted for an extended period of 9 months, (*c*) comparing the results of the above two groups with a view to establishing the

superiority of the one over the other. Literacy attainment meant reading and writing speed which are only a part of the whole complex of functional literacy test items. The secondary objective was to compare and try out new Test papers both After Primer and Functional Literacy Test papers prepared by the Literacy House.

4. Chapter 2 gives an account of the methods of study; organisation of classes; Control and Experimental Groups, selection, training, recruitment and particulars of teachers and pre-testing etc. and teaching adults. After final enrolment of 255 adults in all the ten classes, teaching started as per programme. Dates of conducting the Tests have also been provided.

5. Chapter 3 deals with Findings on (*a*) Background Characteristics of Adults such as: Age, Marital Status, Caste, Occupation, (*b*) Attendance, (*c*) Literacy Test Participation, (*d*) Number of Participants in the Functional Literacy Test, (*e*) Writing Speed, (*f*) Reading Speed, (*g*) Statistical Camparison of group means both in reading and writing speeds.

6. Chapter 4 discusses the items mentioned in Para 5 above. The Findings and Conclusions are very interesting and have been provided in the last chapter. In view of their significance, I am prompted to give below these findings in some detail:

(i) Over 81 per cent adult literacy participants were young adults (35 years and below).

(ii) Nearly 77 per cent participants were married.

(iii) About 73 per cent participants belonged to scheduled castes and another over 26 per cent participants belonged to backward castes.

(iv) Over 96 per cent were engaged in farming and labour.

(v) Over 70 per cent participants did not attend classes for more than 120 days.

(vi) Participation in After Primer Test was only 68 per cent of the enrolment.

(vii) Participation in the functional literacy test was more in the test conducted after 9 months than the participation in this test conducted after 6 months.

(viii) Average writing speed after 9 months was more by 1.4 words per minute than the average writing speed after 6 months.

(ix) Suprisingly average reading speed was less by 2·4 words per minute after 9 months than that it was after 6 months.

From these findings, a few tentative conclusions have been drawn:

(i) Participation in rural adult literacy classes will be more from the younger age-group, belonging to backward and scheduled caste communities engaged in farming and labour.

(ii) Reading speed will not increase beyond 6 months period unless deliberate effort was made to do so.

(iii) Writing speed will be more when classes continue to function for 9 months than when the classes are conducted for 6 months.

7. On the strength of the above-stated findings and conclusions it is suggested that literacy programme planners, curriculum builders and literacy organisers and workers should keep in mind the background characteristics of the adults in rural areas for more effective approach to literacy education.

8. In the light of the findings, a literacy programme for rural areas may concentrate on enrolling young adults with 35 years age and below, and the subject matter may concentrate on agriculture. Further, as the scheduled caste and backward caste people, at present, are more receptive to literacy programmes, the villages with concentration of these communities may be selected for organising literacy classes.

9. Enrolment procedures need to be reconsidered. It requires a little ingenuity on the part of literacy teachers to select adults for final enrolment. More careful enrolment procedures would reduce the rate of absenteeism and drop-out.

10. It becomes necessary to understand the motivation level of adults because high motivation has always gone with persistence, perseverence, regularity and high achievement. Thorough research in this direction is urgently needed. It can be said that no empirical study is available in the field of literacy education in India which deals with measurement of achievement motivation for literacy and its relationship with literacy-behaviour and attainment.

11. It may be pointed out that the six months period is inadequate. In view of the facts that adults are generally irregular; in most of the cases 2 hours daily teaching is not done; the quality of teachers is poor; and the classroom facilities are inadequate—it is difficult for the adults to attain the level specified in the six months functional literacy syllabus, within this period.

> "No doubt, if all the conditions are met ideally, the literacy attainment level should be up to the mark but unfortunately the actual situation is far being the ideal."

12. Moreover, there are times when it is practically impossible to have good attendance such as sowing and harvesting times. Also it is very inconvenient to conduct classes and supervise them and administer tests during rainy season in rural areas. It would be more practical to start classes in early September and close them before the arrival of monsoon. The classes may, therefore, be conducted for a period of about 9 to 10 months.

13. It is needless to stress that literacy workers specially literacy project supervisors, and teachers need to be properly and thoroughly oriented in record keeping and collecting other information and data which have to be utilized by researchers and evaluators as " secondary " data in conducting researches and evaluative studies. The quality of a study basically depends upon the quality of the data used in the study.

14. As mentioned earlier this is a useful study. Many more studies both of this type and impact Studies " will, however, have to be conducted before we could establish the superiority of functional literacy approach over the traditional one. I congratulate Shri R. Shankar, and the Literacy House, Lucknow, for conducting this interesting experiment and for bringing out its report in a lucid form, which would be understood and utilized by adult literacy workers at different levels not only in India, but in other developing countries.

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Attitudes of Calcutta Job-Seekers

Personal Characteristics of The Unemployed Youths of Calcutta—a Social-psychological Study

Debabrata Banerjee, G. G. & Co. Calcutta, 1973.

The book briefly presents a revised version of the Ph. D. thesis entitled 'Attitudes and other personality traits of unemployed and employed undergraduates: a comparative study' approved by the Calcutta University in 1964. No doubt, as conceded by the author himself, the study is somewhat incomplete and exploratory in nature.

The book has been devided into seven chapters dealing with introduction, the problem, early studies, procedure, construction of attitude scales, the results and interpretation and lastly the summary and conclusions. These chapters have been followed by list of references nd appendices containing tables and the attitude and personality tests. The author has kept the language of the book at a simple level though illustrations by graphs and pie diagrams would have certainly added to the usefulness of the book.

As the author concedes in the preface, the book is not exhaustive in its treatment. The vastness of the perennial problem of unemployment cannot be condensed to just the nature of the experience of the unemployed and the study of group differences in some selected personality variables. In the introductory chapter which hardly covers three pages the author could discuss the vastness of the problem of employment and its social, psychological and economic implications in much greater details so as to develop in the reader a background of the problem under investigation. The problem has been stated in the second chapter but its delimitation has not been specifically given. It would have been desirable to state the specific objectives of the study. The broad objective—to studying the effects of forced idleness on the personality of normal people capable of pursuing a normal remunerative occupation—does not clarify what exactly the investigator plans to find out.

The author has summarised only a few studies done in U.S.A. during forties and fifties. Since the book was published in 1973, it

would have been better if some important studies conducted abroad in this field could also be included to make this chapter comprehensive. In fact the author has tried to summarise some selected foreign and Indian studies instead of reviewing them and presenting a good critique.

The author has postulated eight hypotheses (not in null form) which have been claimed to be tested statistically. No attempt has been made to give the rationale and the basis for each of the hypotheses. One of the purposes of the review of earlier studies is to seek some logical basis for stating a hypothesis. The real skill of the investigator lies in the soundness of the rationale for a hypothesis. This gives a direction to an investigation.

The sample of subjects was rather inadequate. The experimental and the control groups consisted of 200 subjects each. This number could be hardly representative of the population under study, particularly when the criteria for selection of subjects were partly arbitrary and partly determined by the nature of the tests used. The author constructed an attitude test in Bengali consisted of four scales measuring attitude of the subjects towards government, morality, religion and society. It would have been desirable to seek information regarding subjects' attitude towards concepts like Education, Employment, Industrialization, Modernisation since these concepts have direct relevance to the problem of unemployment. For measurement of personality characteristics, the author used the short Bengali version of Mahanta who adopted the BPI (Bernreuter Personality Inventory) version developed by Gayen and Saha. The reliability and validity indices of the Bengali version of BPI have not been reported and hence it is difficult to comment on the appropriateness of the personality test used.

Chapter VI presents briefly the results of the investigation. On page 15, the author has stated that the hypotheses were statistically tested but the reviewer fails to find full discussion of results as per hypotheses stated on page 16. However, some passing reference relating to hypotheses 1 to 4 has been made on page 37, para 2 and 3.

The hypotheses have been referred to as null-hypotheses whereas these were never stated in the null form. No reference has been made regarding hypotheses 5 to 8 in the discussion of results. This chapter on the whole has been very sketchy.

The author could have planned some follow-up work of his Ph. D. research in order to confirm the changes in personality characteristics

as permanent or just a passing phase depending on the period during which the individuals were unemployed. The findings of the follow-up study would have made the reading of the earlier results interesting.

One gets the impression that the author has dismissed vastly ramified topics such as causes of unemployment, socio-economic background and the differences in the mental make up of the two sexes etc., as unimportant and unnecessary. It would have been much revealing if the discussion on these variables could have been included in the book. Merely restricting its scope to the Ph.D. dissertation has limited the utility of the book.

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